DOCUMENT RESUME

ED 187 576 SE 031 005

TITLE	Minority Institutions Curriculum Exchange Conference Proceedings (Washington, D.C. January 19-20, 1979).
INSTITUTION	Barber-Scotia Coll., Concord, N.C.
SPONS AGENCY	National Science Foundation, Washington, D.C.
PUB DATE	79
CONTRACT	SER-78-25812
NOTE	148p.
EDRS PRICE	MF01/PC06 Plus Postage.
DESCRIPTORS	College Science; Computer Oriented Programs; *Curriculum Development; Educational Strategies; *Higher Education; Methods; *Minority Groups; Minority Group Teachers; Natural Sciences; *Resource Centers; Science Curriculum; *Science Education; Science Programs; *Social Sciences

ABSTRACT

Presented are papers from the Minority Institutions Curriculum Exchange Conference held in January 1979 in Washington, D.C. The goals of the conference, supported by the National Science Foundation, were to facilitate contact and exchange of information among natural and social science faculty representatives at minority institutions, concerning advances in curriculum development and instructional techniques. The presented papers are divided into six sections: (1) Instructional strategies in the natural and social sciences; (2) Computer-assisted instruction; (3) Panel discussion on technical systems for academic computing; (4) Reinforcement of academic skills; (5) Interdisciplinary courses and career opportunities; and (6) General instructional strategies. A description of the Atlanta University Resource Center in Science and Engineering is included. Summary descriptions of minority-focused programs in federal agencies, the conference program, a list of registered participants, and the keynote addresses are also presented. (HM)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED187576

MINORITY INSTITUTIONS CURRICULUM EXCHANGE CONFERENCE

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

PROCEEDINGS

January 19-20, 1979

Washington Hilton Hotel
Washington, D.C.

The Conference was supported by the National Science Foundation under contract (#SER 78-25812) to Barber-Scotia College, Concord, North Carolina. Any opinions, findings, conclusions, or recommendations expressed herein are those of the authors and do not necessarily reflect the views of the Foundation.

SE 031 005

APR 1 7 1980

ADVISORY COMMITTEE

Coordinator: **KOOSAPPA RAJASEKHARA**
Professor of Biology
Barber-Scotia College
Concord, North Carolina

Members: **DON AHSHAPANEK**
Instructor of Biological Sciences
Haskell Indian Junior College
Lawrence, Kansas

JOSEPH McPHEE
Assistant Professor of Natural
and Applied Science
CUNY LaGuardia Community College
New York, New York

SIGFREDO MAESTAS
Professor of Chemistry and Dean of
Academic Affairs
New Mexico Highlands University
Las Vegas, New Mexico

JAMES PERKINS
Professor and Head, Department of
Chemistry
Jackson State University
Jackson, Mississippi

NELLOUISE WATKINS
Associate Professor of Mathematics
and Director, Computer Center
Bennett College
Greensboro, North Carolina

SUPPORT STAFF

SHEILA ALLEN, MARTHA PORCHER
Barber-Scotia College
Concord, North Carolina

PREFACE

These *Proceedings* are from the Minority Institutions Curriculum Exchange Conference held on January 19-20, 1979 at the Washington Hilton Hotel, Washington, D.C. The goals of the Conference were to facilitate contact and exchange of information among natural and social science faculty representatives at minority institutions, concerning advances in curriculum development and instructional techniques which may enhance the quality and effectiveness of science education at minority institutions.

An expected outcome is that the participating institutions will continue to share or exchange science related information and materials after the Conference.

Papers included in these *Proceedings* are those presented at the Conference. The keynote addresses are printed in their entirety. In addition, the Conference Program has been included.

Within these *Proceedings* papers on curriculum development and instructional techniques have been divided into six sections, as follows: *Instructional Strategies in the Natural and Social Sciences, Computer-Assisted Instruction, Panel Discussion on Technical Systems for Academic Computing, Reinforcement of Academic Skills, Interdisciplinary Courses and Career Opportunities, and General Instructional Strategies.* A description of the Atlanta University Resource Center in Science and Engineering has been included. Summary descriptions of Minority-Focused Programs in Federal Agencies are also given. Requests for additional information or copies of individual papers described in this volume should be directed to the authors, whose names appear in a complete listing of registered participants in the last section of the book.

Even though this Conference was held primarily for the benefit of faculty at minority institutions, it is hoped that the information contained in this publication will be of value to faculty and administrators at other institutions of higher learning as well.

May 1979

Koosappa Rajasekhara
Conference Coordinator

ACKNOWLEDGEMENTS

The Coordinator wishes to express his deep appreciation to the members of the Advisory Committee for their advice and counsel in the planning and coordination of the Conference. Special thanks are due to the keynote speakers, representatives of federal agencies, moderators, resource persons, and presenters for their participation. Deep appreciation is extended to the participants who gave their time to make this Conference a success. Appreciation is also extended to the scientific companies for presenting exhibits and to the faculty who displayed their MISIP-supported materials at the Conference.

The Coordinator expresses his deep gratitude and appreciation to Dr. Mable P. McLean, President of Barber-Scotia College, for her continued support of this project and for delivering the Welcome Address at the Conference. Heartfelt thanks are due to the members of the MISIP staff for their constant support and guidance. Appreciation is due to Dr. James Haviland, Assistant Professor of Biology, Barber-Scotia College, who assisted the Coordinator in the editing of the *Proceedings*. Special acknowledgement is extended to Mrs. Sheila Allen, Mrs. Martha Porcher and other members of Barber-Scotia College staff who worked diligently to assist in the success of this project.

PROCEEDINGS
TABLE OF CONTENTS

Advisory Committee i

Preface iii

Acknowledgements v

I. **KEYNOTE ADDRESSES** 1

Future Role of Science at Minority Institutions. 3
Joseph N. Gayles, Jr.

Training Minorities for the Science Careers of the Future. 9
Walter E. Massey

II. **INSTRUCTIONAL STRATEGIES IN THE NATURAL AND SOCIAL SCIENCES** 15

Employing Behavioral Objectives and Drill to Improve Student Comprehension and Retention in Organic Chemistry at Xavier University. 17
John P. Sevenair (Presented by Joyce Corrington)

Modular System of Instruction for General Chemistry. 19
Marcelina Velez de Santiago (Presented by Carmen Valasquez)

Multi-Pathways to Learning General Chemistry: PSI Lecture with Paiget-Based Laboratories. 21
Mary Ann Ryan and J.W. Carmichael, Jr.

Instructional Strategies in Biological Sciences – Videotape Presentation of Basic Biological Concepts. 23
George W. Miskimen

Individualizing Courses in the Social Sciences: The Blending of A/V Modules and Personalized Self-Paced Instruction. 25
Frank Brimelow

Teaching Innovations in Applied Economics. 28
Alice E. Kidder

Modernizing Instructional Capabilities in General Experimental Psychology at Tennessee State University. 30
Helen R. Barrett

Planning the Behavioral Sciences Laboratory at Texas Southern University. 32
Edward C. Powell

III. **COMPUTER-ASSISTED INSTRUCTION** 35

Using the Computer in the Teaching of Science. 37
James D. Beck

Increasing Success in and Undertaking of Science among Urban Minority Students (Project ISUS). 39
Carl Polowczyk

Computer-Assisted Instruction in General Chemistry. 41
Alex Bonilla and Manuel Gomez-Rodriguez

Scientific Academic Computer Planning Process. 43
John Garner

Innovative Instructional Uses of Computers at Jackson State University. 45
Jesse C. Lewis

Interactive Computer-Assisted Drills and Exercise in Science Courses at Hostos Community College. 47
Amador C. Muriel

IV. PANEL DISCUSSION ON TECHNICAL SYSTEMS FOR ACADEMIC COMPUTING 49

Technical Systems for Academic Computing. 51
Nellouise Watkins

V. REINFORCEMENT OF ACADEMIC SKILLS 55

The Development of an Academic Support Facility for the Sciences. 57
Richard G. Ross, Ernest J. Baca and Robert I. Lonard

The Guided Initiative Academic Advancement Reinforcement Systems Approach—A Viable Alternative to Traditional Science Education. 59
J. Henry Sayles

Development of Basics in Mathematics and the Sciences: "Lecture-Laboratory Format". 60
Darius Movasseghi and Mahendra Kawatra

Student Motivation and Achievement at Our Lady of the Lake University. 62
Michael E. Campbell

Reinforcement of Basic Skills in Chemistry I Course. 64
Mary Abkemeir

Reinforcement of Computational Skills at Norfolk State College. 66
Phillip McNeil

Eliminating "Mathematical Illiteracy" at the Freshman Level: A Modularized Mathematics Program. 68
Argelia Velez-Rodriguez

Development of Supportive Materials in Mathematics and Science in a Lecture-Laboratory Format. 71
Mahendra Kawatra and Darius Movasseghi

VI. INTERDISCIPLINARY COURSES AND CAREER OPPORTUNITIES 73

On-The-Job Training of Students in Computer Science. 75
Ronald G. Selby and Manuel Gomez-Rodriguez

An Interdisciplinary Seminar in the Behavioral, Natural and Social Sciences. 77
Clemmie E. Webber

Urban-Environmental Studies: An Interdisciplinary Approach. 79
Kathryn Brisbane

A Capstone Interdisciplinary Course in Values and the Sciences for the General Education Curriculum. 81
Sister Isabel Ball

Development of an Aquaculture Training Program in Alaska for Minority Students. 84
Mel Seifert

Internships: Achieving Linkages Between Scientific Disciplines. 86
Elmer L. Washington

Career Opportunities in Science. 88
Tae Y. Nam

The Challenge of Interdisciplinary Studies. 90
William J. Nelson

VII. **GENERAL INSTRUCTIONAL STRATEGIES** 93

What Does Piaget Tell Us About Teaching Science? 95
George Oleh Kolodiy (Presented by Mary Abkemeier)

Strategies in Science Instruction in a Junior College Setting. 97
Bettaiya Rajanna

Instructional Strategies in the Natural Sciences. 99
Ajeet S. Randhawa

Application of Techniques and Technology to Social Science Instruction. 101
Thomas Ray McAllister

Integration and Interfacing of Instructional Technologies — The Application of the Principles of Learning Theory to Instructional Design. 103
Frederick Dumser, Jr.

Using a Videocassette System as a Part of an Effective Instructional Strategy. 106
Timothy Hunt

Culture Sensitive, Quality Science Education at Navajo Community College. 108
Carl Hime

The Use of Programmed Units and Learning Objectives in an Experimental Psychology Undergraduate Class. 110
Lendell W. Braud

VIII. **RESOURCE CENTER FOR SCIENCE AND ENGINEERING** 113

The Atlanta University Resource Center for Science and Engineering. 115
Thomas W. Cole, Jr.

IX. **MINORITY-FOCUSED PROGRAMS IN FEDERAL AGENCIES** 119

X. **CONFERENCE PROGRAM** 135

XI. **LIST OF REGISTERED PARTICIPANTS** 143

I. KEYNOTE ADDRESSES

Future Role of Science at Minority Institutions.
Joseph N. Gayles, Jr.

Training Minorities for the Science Careers of the Future.
Walter E. Massey

Keynote Address - January 19, 1979

FUTURE ROLE OF SCIENCE AT MINORITY INSTITUTIONS

Joseph N. Gayles, Jr.
President, Talladega College

This conference is designed to address the concerns of a broad cross-section of American minorities. Realizing this, I will reflect on my experiences as a black person in predominantly black institutions. Many of my comments, however, will be directly transferable to other minorities. Toward this end, I have called upon friends in other minority groups to assist me in gaining a broader, more ecumenical, if you will, view of minority concerns in science.

I think it is important for me to tell you what I understand minority institutions to mean. I see them simply as those institutions with an overwhelming minority student population and I hope substantial minority faculty and administrative leadership. Now this definition might seem to be an oversimplification. It seems to me, however, that the definition gets to the crux of those characteristics which make minority institutions functionally distinct from majority institutions. I believe that within the confines of this definition we can count institutions that serve the half million plus Native Americans, the million plus Puerto Ricans, the six million plus Mexican Americans, and the 23 million plus Black Americans.

The theme of the conference is the Future Role of Science at Minority Institutions. I submit that we should ask ourselves hard and tough questions about the present role of science at minority insitutions, or the present role of minority institutions in science. On this point we have our work cut out for us. Two books published in 1977 and 1978, respectively dealt in a broad and comprehensive way with the "State of Academic Science." (Bruce L.R. Smith and Joseph J. Karlesky, 1977. The State of Academic Science: The Universities in the Nation's Research Effort, Change Magazine Press, New Rochelle, N.Y.: Bruce L.R. Smith and Joseph J. Karlesky ed. 1978. The State of Academic Science: Background Papers, Change Magazine Press, New Rochelle, N.Y.) Many powerful and provocative conclusions emerged from this work, but no minority scientists were involved in the making of those conclusions. No minority concern—even manpower—was even obliquely hinted at in this work. We just weren't there. I was not surprised. Just disappointed. Disappointed that minorities were regarded essentially as non-persons in the state of academic science. Disappointed that no reference was made to the need for minority access to science careers. Disappointed that no reference was made to the need for minority student choice in developing access to careers in science. The fact that this is the case and has been the case for too long means that we must work together and speak with one voice as America's major minorities. For we have common enemies: ignorance, or educational deprivation; poverty, or joblessness and socio-economic deprivation; and racism, and nowhere is this more apparent than among some of the elitists in science. In a real sense, the future role of science at minority institutions, or among minorities, depends on our ability to stick together, to work for common goals, and to resolve among ourselves any conflicts that counteract our success in science. To the extent that we divide among ourselves, we will be conquered by the very forces that create problems for us as a people. To the extent that we work together, not blind to problems but devoted to solutions, we will increase our participation in the state of academic science.

As I gave careful thought to the theme of this conference, again and again, one major concern pressed itself on me. That concern is the need for minority student access to careers in science. Access because every American Indian, Chicano, Puerto Rican, Black boy or girl should enter first grade, scrubbed, bright-eyed and assured of every chance of becoming a doctor, a researcher, or some other specialist in the area of science. We know that this is all too often not the case.

Related to the theme of access is the very important theme of choice in determining the path of access to a career in science. Let me explain what I mean by choice. I believe that minority students should be able to choose minority institutions that serve their needs and their interests as they pursue careers in science. I believe they should be able to obtain at minority institutions all the training they need to become capable and outstanding scientists. The traditional path to access available to white students at institutions that serve the majority is often not the most creative and successful path for minority students. That path presents many barriers that our students are ill-equipped to handle. Let me add quickly that what is involved here is not the so-called process of natural selection, for the majority-oriented traditional path to access to science had bonuses for the young, white male and biases, built-in biases, against minorities. What is involved is not, therefore, "natural selection." Rather it is unnatural, prejudicial selection.

In addition to the themes of access and choice, there is the need for a strong, strident, persistent and clear voice on the part of minority scientists. We need to constantly—constantly—stress the capability of minority institutions to do UNIQUE things in American Higher Education. It is our unique mission to serve an underserved or un-served minority student population.

You know, Harvard, MIT, Berkeley, and other majority institutions might not want Talladega students when they are ready to enroll in college, but they sure want them when we graduate them. I've got a few hundred, even a thousand, case histories to prove that point. Beyond question, our unique ability is to motivate our young people to exceed their own expectations and to get young ladies to do at least as well as their male counterparts. Other institutions realize the excellent job we have done and continue to do in this area and that is why they actively recruit in our institutions. Our uniqueness in this regard is our reason for being, our existing, prospering and moving on to hard-won, new and higher levels of contributions to American society and contributions to the salvation of our people.

But even in view of our success in training minority students for excellent graduate work in science, we have reason for concern about our future role in science, and in other fields as well. Grim statistics reveal under-representation of minorities in science.

DOCTORAL DEGREES IN SCIENCE ARE INDICATORS: (1973-74)

	% Pop. (1979)	% Sci. Doc.	Under-rep. Factor
Native Americans	0.4	0.4	———
Puerto Ricans	0.7	0.2	3.5
Mexican Americans	3.9	0.4	9.8
Blacks	11.1	1.8	6.2

(Information from the National Science Foundation; "Total and Pecentage Distribution of Doctorates Awarded Overall and in Science in 1973-74 and Percentage Distribution of U.S. Population in 1970, by Race and Ethnic Group" (SERI 78-170; 11-77)).

Let us look briefly at data on minorities in medicine. These data corresond to the black experience because that is the one with which I am most familiar, but I believe they reflect what is happening for other minorities in medicine. The growth of black enrollments in U.S. medical schools peaked at 7.5% in 1974. The Sloan Foundation had predicted in 1974 a black enrollment of 18% in the nation's medical schools. But since 1974, black enrollment in medical schools has steadily declined from 7.5% to 6.4%. Instead of the increase we had all hoped for and expected, we are experiencing a dramatic and frustrating decline. (Refer to the Association of American Medical Schools, Washington, D.C.).

Another reason for concern is that too few minority students are earning bachelor and graduate degrees in science. Look at the data:

	In 1st grade	Earning bac. in sci.	Earning grad. deg. in sci.
White	100	5	1.7
Black	100	3.5	0.51
Mexican American	100	1	0.16
Native Ameican	100	1.5	0.25

(Natural Science Foundation; "Educational Flow Patterns-Percent First Graders at various Educational Levels" (SERI 78-167; 11-77) from Joel B. Aronson, "An Analysis of Supported Projects to Test Methods for Increasing the Access of Ethnic Minority Students to Careers in Science and Technology", Vol. 1 Executive Summary, American Institutes for Research, November, 1976.)

What are minority students choosing as their major? Too often it is education. This is a serious problem because a recent SREB report predicts that there will be 52,800 openings in education in the south by the year 1985 with an expected 71,500 market ready degree holders (assuming there is no in-migration, and there will be in-migration). On the other hand, jobs in health-related and science fields have good to excellent supply and demand ratios. It is clear that we minority scientists need to do a better job of motivating our young people to study science, not education. (Marilu H. McCarty and Eva C. Galambos, Supply and Demand for College Graduates in the South, 1985, Southern Regional Education Board, Atlanta (1978)).

Equally important is the need to counteract the brain drain that afflicts many minority institutions in this nation. The competition for talented faculty and minority institutions on the part of white colleges and universities is what I have reference to. Let's face it. Too many of us are leaving minority institutions. And I am not speaking solely of minority faculty, though their presence in substantial numbers at minority institutions is crucial and necessary. I am also talking about the legions of non-minority scientists—white, Asians and others—who have made and who continue to make significant contributions to the education of minority youth. Many of our best teachers at Talladega, for example, are not minorities, are not blacks. They have been there for many years and will die with their boots on on the campus. They gave and they give their last measure. We have always welcomed them and admitted a need for them. So has this been true in minority institutions that are not predominantly black. Minorities in this country have been embracing people, and so have their institutions. In that sense, people outside the ethnic or racial group who join hands with us in the struggle for quality education have been home folks. So, I say to minority and non-minority scientists; I know it's tempting to go elsewhere, but stay HOME. And if you leave home, by all means return home.

The student brain drain is another problem we must address. The signals are somewhat mixed. White institutions know of the projected accelerated decline in the number of college age youth. They also know that the number of minority college age youth will not decline as rapidly as the number of white college age youth. Given the live births and birth rates of minorities in this nation, the proportion of minorities in the college age population is seen as a real plus, an avenue to survival in many instances, by a number of white institutions. They will recruit aggressively for our students.

What results has this recruitment or "integration" had? It has meant, for example, in the case of black Americans a disturbing drop in the percentage of black youth who attend predominantly black colleges. In 1965, 82% of total black enrollment in the south was in predominantly black colleges. By 1976, the figure dropped to 43%.

But note well, though black colleges in the south now enroll 43% of black students in the region, they provide 69% of black graduates. This should be compared to national data of 25% enrollment, 50% graduates; 25% to 26% of black students are being shredded at white colleges. (James R. Mingle, Black Enrollment in Higher Education: Trends in the Nation and in the South, Southern Regional Education Board, Atlanta, (1978)).

In a study by Alexander Astin, published in 1976, data showed that blacks in black colleges have a dropout-stopout pecentage of 37. In white colleges that percentage rises to 50%. Astin wrote and I quote: "The higher attrition rate (in white colleges) appears attributable in part to the effect of attending a white college rather than to differences in initial dropout-proneness between blacks in white colleges and black students in black colleges." (Alexander W. Astin, Preventing Students from Dropping out, Jossey-Bass, San Francisco (1976)). He further noted in a later work, and again I quote, "Attending a black college increases the black students' chances of implementing career plans in a variety of fields: college teaching, nursing, medicine and science." (Alexander W. Astin, Four Critical Years, Jossey-Bass, San Francisco (1977)). I know that the experience is similar for other minority students in institutions that address their needs and their cultural interests.

It is amazing to me, in light of the proven success of minority institutions, that some people question whether or not we should continue to exist. We can offer many reasons for our existence and, likewise, many explanations for our history of success. Among them are the following:

1. Our institutions are oriented to fulfill the talents of minority students, giving them minority models.
2. Our institutions offer academic specialization not stereotyped by race. Just because you are a minority, you don't have to major in basket weaving. You can pursue a career in medicine or science, and we will push you to do so.
3. Our institutions offer students an opportunity to share experiences with other minorities, giving students in the process a sense of personal dignity and personal worth.
4. Our institutions minimize dilution of talent by ignoring efforts to maintain artificial racial balances.
5. Our institutions teach minority students what is expected of them, needed of them, and what must be delivered by them. They offer support systems for students that say the minority community is behind you, pushing you, and expecting you to succeed.
6. Finally, our institutions are the very last place where you will hear someone say you can't do something because you are poor or black or a Chicano or a Puerto Rican or a Native American.

Because we do all these things, and many more than time will permit me to list for you (and you know them already), it is not surprising that minority institutions produce a higher proportion of students in the biological, physical and social sciences than do major institutions. The report by Astin, you will recall, made note of the high productivity of graduates of predominantly black institutions. We should also note the high productivity of other minority students in key western, a few midwestern, eastern, and Puerto Rican Universities. (See above James R. Mingle SREB Report (1978); see also Women and Minority Ph.D.'s in the 1970's: A Data Book, Commission on Human Resources, National Research Council, National Academy of Sciences, (1977)).

I don't want to be chauvinistic and toot Talladega's horn, but in terms of rate of our productivity, we are quite high, some say even the highest, This is rate, mind you, not gross numbers, but that is in bad taste so I won't say that. (See A Note on the Production of Doctorates and Law Degrees Among the Graduates of Talladega College, Herman Long (1972); Revised by A.L. Tucker, (1978), available from Talladega College, Talladega Alabama 35160.)

So minority institutions have a significant role in turning minority students on to science in the future. We have a significant role, as I have said, because our unique mission and our unique ability to challenge and motivate students have given us an enviable record of achievement and success. And though there are problems on the horizon, we have no reason to believe that our future record of achievement will be less than our past or present record. It will be greater.

But we have a significant role for another reason. We are needed in science to protect minority persons from the unscrupulous use of science.

You know, science can make pretty terrible blunders in human relations. I mean, it can offer scientific data to the nation that seriously affect race relations. Sometimes the blunders are so ridiculous as to be entertaining jokes, even in a mixed group. Take for example the latest report on the color of one's eye and the relationship between that color and one's predisposition for violence.

I will quote from a study reported by "prominent" scientists in a psychological association meeting (Atlanta Journal, Wed., April 9, 1975). "We all learn how to commit violence by watching violence on television. But for reason yet to be explained, the dark-eyed person on the average learns through violence on television how to commit violence far more effectively than a light-eyed person." At the same conference and reported in the same newspaper article, another "prominent" scientist said that dark-eyed athletes were significantly better than blue-eyed athletes when it came to performing in sports requiring speed and quickness of reaction. Continuing, he said, on the other hand, light-eyed athletes were significantly better when they could set their own pace such as a football quarterback, the baseball pitcher, or the bowler. Therefore, said another "prominent" scientist, that may be the reason why relatively more blacks, most of whom are dark-eyed, reach the major league as hitters and not as pitchers.

This "research" was further elaborated in a recent newspaper article and several "learned" journals. ("Watch out for Black-eyed Boss," Anniston (Ala.) Star, Dec. 10, 1978. See also A.L. Gary, et al., Journal of Psychology, *96*, 315 (1977)). Now if that isn't humorous, I don't know what is.

But not all unscrupulous reserach in science should be taken lightly. We can never forget scientific experiments on the defenseless poor. The Tuskegee syphyllis experiment is a classic example of scientific research that is, at its very roots, a crime against humanity. And there are other examples of this kind of criminal scientific research. Experiments on inmates in prisons across the nation. Operations on the poor in charity hospitals, operations that are major and life-threatening, but are performed by an orthopedic appliance salesman. I could go on, but I won't. The point is that minority institutions have a special role as guardians over the kind of scientific research that, whether intentionally or unintentionally, does harm to the mind, the body or the visions of minorities in this nation.

We've talked about concerns related to minority institutions in academic science and we've talked about our role in the future of science. What of major actions and responses to these concerns?

It is my feeling that minority institutions constitute a major unique national resource that is yet to be developed properly. Let's "mine" them for minority scientific manpower with the same efficient enthusiasm that we mine coal for energy problems. Let's not have high officials in the public sector saying that our institutions are weak financially or that they don't have enough accountants on the payroll. The fact that we are here, that we have survived is a miracle of the second order and the fact that we have achieved is a miracle of the first order. Let us take note of the fact that one third of the predominantly black colleges founded between 1865 and 1950 are no longer in existence. (Henry G. Badger, Journal of Negro Education, *35*: 306 (1966)). First the public sector fails to support minority institutions and then cites weakness as a reason to discontinue the modicum of support it has offered.

We are grateful for the bright spots in the picture. NSF's MISIP program is one such spot. And there are MBS, MARC, HRA and smaller efforts by NASA, EPA, DOE, Labor, NOAA and others. The foresight and, in many cases the courage, that urges the public officials to continue to fight for these efforts is inspiring.

But there must be a wider federal role. A wider role in part because the private sector—the foundations and corporations—have been responding in erratic ways and never at the level of resources that are required.

We have a problem when federal support of black colleges, excluding Howard and Meharry, is only 4% of the total support offered for higher education. (Federal Support of Black Colleges and Universities, Fall 1978, 1, Institute for Services to Education, Inc.; Federal Obligations to Colleges and Universities by Agencies, fiscal year (1976) NSF), Table I C.) Look at the figures:

14

	All Colleges	Black Colleges
Defense	$223,733,000	0.1%
NSF	496,326,000	0.9%
Interior	28,218,000	0.4%
Army	50,039,000	0.0%

We have a problem. And to hammer away at this problem, we must become closer to the political process and make demands on the interest of minority institutions and their future role in academic science. I read recently an excellent paper by Dr. Miguel Rios, Jr. presented before the National Science Board, addressing some of the concerns I have raised. (Miguel Rios, Jr., Statement to the National Science Board in behalf of the Society of Advancement of Chicanos and Native Americans in Science (SACNAS), January 10, 1978.) This is what I mean by involvement, by hammering away at the political process. We must take time to study the issues. For example, higher education bills are up for renewal and we must provide oral and written testimony on the issues, or on the bills that affect the role of science in our institutions.

Finally, let me urge you to insure our future as institutions and as minority scientist by:

1. Pressing constantly for acceptance by the public sector of the concept of financially guaranteed access and choice in higher education for all high school graduates.
2. Pressing constantly for political readiness to support minority institutions in such a way that they become an even greater educational asset in science, including building them to a point of parity with white colleges in all aspects of graduate, professional and undergraduate science teaching and research.
3. (Sometimes we get as preoccupied with presenting our case in Washington or in the halls of predominantly white academe that we forget to do our homework.) Seeking strength from our minority communities and reporting back to them on our achievements. Not only do the people in our communities have votes, they must believe in us so strongly that they will continue to give to us in greater numbers their most prized possesion — their children — our future.

Let me repeat the themes: access, choice, uniqueness. But more—let us rededicate ourselves to excellence with all the pain, suffering, disruption and agony that go along with any worthwhile change. Let us seek a renewal and regeneration of the moral and mental force that has historically under-girded our mission. Let us police ourselves. Let us encourage criticism from within and without and convert those criticisms to specific purposes.

We must work individually and collectively for uniqueness, competence and excellence. But perhaps most of all, we must in our individual minds and consciences mount a heroic effort to save our institutions and our students from failure to achieve high purpose in their lives.

Keynote Address - January 20, 1979

TRAINING MINORITIES FOR THE SCIENCE CAREERS OF THE FUTURE

Walter E. Massey
Dean of the College and Professor of Physics
Brown University

It is a pleasure and honor to address this Conference on the topic of preparing minorities for the science careers of the future. However, the title reminds me of another symposium in which I participated recently. It was the occasion of the inauguration of the new Chancellor of the University of California at Santa Cruz, and the theme of the symposium was "Liberal Education for the Twenty-First Century." A number of students pointed out that it was a bit premature to focus on the twenty-first century, for that implied that the problems of attaining a liberal education appropriate to the present century had been solved. A rash assumption to say the least. I think a similar position can be taken relative to the topic I have been asked to address. It may not be premature to begin now to think about ways of preparing minorities for the science careers of the future, but it does behoove us to consider the situation as it is now and to see what lessons we may learn from the present status and participation of minorities in scientific fields. For I would argue that unless we can increase the rate of participation of minorities in existing science careers, our hopes for the future may turn out to be unfulfilled dreams.

In reviewing the present situation and the recent past, there are reasons to be optimistic about minority participation in science, but not as much as one might have expected looking forward from around 1970 to the present. Although there has been growth in the number of minorities achieving doctorates or equivalent terminal level degrees in some applied fields such as engineering and medicine, the picture has not been nearly as encouraging in the basic scientific fields such as Biology, Chemistry, and Mathematics, and especially—Physics. (I should say that in my remarks today, I will address the Physical Sciences.) Unless we can understand why we have not made more progress we may find our participation in those science careers of the future to be just as marginal and peripheral as is our participation in the science careers of the present.

The prospects for increasing the numbers of minorities in science careers is obviously directly connected to the increased participation of minorities in higher education, for that is the only existing source of scientific training. Let us review where we have come over the past few years and where we are now. In much of what I will have to say I will focus primarily on Blacks instead of all minorities. However, in practically every instance the data is also indicative of the situation of Hispanics and Native Americans. Asian-Americans in some instances may be in different situations. Also, I will use Physics as an example to illustrate some points.

The answer to the question of how much progress has been made depends largely on to whom the question is asked and what is meant by "how much". Among a large segment of the American public—and higher education—there is a widespread feeling that "minorities have made an enormous amount of progress over the past eight years, so much so, in fact, that little more needs to be done, and that possibly too much emphasis is now being put on improving the lot of minorities." As I said, this is the feeling in some quarters. However, the data, particularly in the sciences, does not support such a position.

Blacks represent approximately 11% of the American population, and about 12.5% of the age group between 20 and 24 years. However, at no time has the number of Blacks either entering or graduating from college approached these numbers.

I do not mean to obscure the many real advances which have been made; I only intend to put in perspective those advances. For example, up to 1974 the number of bachelor degrees obtained by Blacks had been steadily increasing over the previous ten years; the predominantly Black colleges alone increased the number of degrees awarded from 16,000 in 1966 to 25,000 in 1973, an increase of almost two-thirds, but a survey conducted by the American Council on Education showed that in 1973-74 only 5% of baccalaureate degrees awarded were obtained by Blacks. I quote from the report issued by the National Board on Graduate Education issued in 1975.

> "The figures for blacks (for baccalaureate degrees awarded) are considerably lower than have been previously estimated, since approximately one-half of all black baccalaureates were conferred by the predominantly black colleges. This fact raises serious questions about the effectiveness of non-black institutions in assisting blacks to not only enter, but to attain a degree. A majority of black students have been enrolled in non-black colleges for several years, but are not graduating from them in similar proportions."

Such data confirm what some of us have known—or at least suspected— for years, that the situation for Blacks and other minorities in higher education is not as good as we would be led to believe by some. Contrary to recently propagated rumors, neither the places in colleges, medical schools, nor the positions on faculties are in danger of being taken over by minorities.

How have we fared in the Sciences and in Physics in particular over the past few years? Less than 1% of practicing physicists are Black (and the percentage for Latinos and Native Americans is even smaller), and although the number is growing, it apparently is not growing as fast as some of us thought it would in our enthusiastic mood of the early 70's. For example, if we look at the average annual growth rate of the Ph.D.'s in science and engineering over the past years from 1970 to 1976, we find that for U.S. citizens as a whole, this growth rate was about 10%, whereas for Blacks the growth rate was approximately 7%. (These figures are for all sciences and engineering. The situation for basic science alone is not very different and was probably worse.) In other words, not only have we not been gaining in achieving parity in Ph.D's in the sciences, we have actually been losing ground. Minorities still attain only about 1% of the doctorates awarded in the Physical Sciences, Math, and Engineering. The picture at the undergraduate level is not particularly more encouraging. Furthermore, most of us do not need to resort to statistical surveys to tell us that something has gone wrong, and that we have not accomplished what we thought we would over the past decade.

As persons concerned with the education and development of minority scientists, we have to be able to answer not only the question "How can the number of minority scientists be increased?" but "Why should the number of minority scientists be increased?" We must be prepared to deal with this question directly, for it will surely be put to us by the higher education establishment, the science community, and most importantly, by minority students themselves.

I think we have to consider seriously the answer we give to minority students who are contemplating a career in science, and I think we have to be very certain of the legitimacy of our own motives before we actively recruit students into the professions.

However, I must admit that my first, spontaneous, "gut-level" reaction to the question "Why increase the number of minority scientists?"—especially if it comes from the scientific-educational establishment—is to ignore the question and to treat it as the insult that it is. The question is tantamount to being asked, "Why do you feel the need to be full participants in the evolution of human civilization?", and "Why do you feel you have something to contribute to the progress and development of the human race?" To have to respond to such questions is demeaning; however, it would be even more demeaning and dehumanizing to have to respond negatively, and in fact not to be full participants in the sweep of human history. I think it can be persuasively argued that the development of science and the scientific "world model" is one of the crowning intellectual achievements of mankind. We cannot afford not to be part of this.

I would like to say a few words to emphasize what I mean by basic science. The need for minorities in the applied fields such as engineering and medicine is not to be questioned. However, this priority should not be confused with the need for more minorities in the basic research areas. Efforts devoted to the former problem do not necessarily lead to solutions to the latter.

A large effort is now being put forth for the education and training of minority engineers, and in fact significant achievements have been accomplished in this area. I applaud and fully support all mechanisms which will lead to an increase in the number of minority engineers and medical doctors—these are much welcomed and long overdue efforts. However, it should be noted that increasing the number of engineers and M.D.'s does not solve the problem of the need for more minority scientists. We need people in both areas—the applied and the basic. There is a need for both engineers and physicists, general practitioners, skilled surgeons and molecular biologists, and for lawyers as well as political philosophers. There is a need for minorities to be involved at the frontiers of the creative developments in science, as well as being skilled practitioners in the applications of technology.

How should we respond to our minority students concerning the need for minority scientists and the prospects for a career in the profession? Before attempting to answer this, it may be useful to have some idea of what minority students desire from higher education and what they seek in the way of future careers. Some indication of this can be gained from the "Freshman National Norms Survey" conducted annually by the American Council on Education. Over the past few years their surveys have shown the following points.

The most popular choice of a future career for freshmen in predominantly Black colleges is business. This is also the first choice of all freshman students (white and minorities) in all four-year colleges. However, less than 1% of freshmen in predominantly Black colleges plan on careers as research scientists, compared to 2½% to 3% of freshmen in all colleges. What are the reasons given for choosing a career? The reason checked most by all freshmen as being very important for a career choice is the desire to "be helpful to others" and to "work with people." Almost three-quarters of the freshmen in predominantly Black colleges and 60% of all freshmen checked this item. However, two-thirds of the students in predominantly Black colleges rate as also being very important, the "availability of jobs" and "high anticipated earnings", compared to less the one-half of all freshmen who rate these as being very important. Approximately two-thirds of the freshmen in predominantly Black colleges plan to continue schooling beyond the bachelor's degree, slightly more than "all freshmen".

Other very interesting items are that whereas 60% to 70% of all freshmen rate themselves as being above average in academic ability, only about 30% of the students in the Black colleges so rate themselves. The trait in which most students in Black colleges rate themselves as being above average is "drive to achieve" (65%). The picture that emerges from those data, of students, or at least freshmen, in predominantly Black colleges—which as I noted earlier is still probably the primary source of Black graduates—is the following: students who have little interest in scientific careers and have a less than exalted opinion of themselves academically, are highly motivated and willing to work very hard to succeed. The students seek careers combining a high degree of economic security with the opportunity to contribute to the well-being of others, and are willing—and plan—to continue in school long enough to obtain the necessary education for such careers.

What can we say to these students concerning a career in science? Well, the first thing we can point out is that there are, and will continue to be, job opportunities in science for talented and motivated students.

Job opportunities and economic security exist in basic science for minorities probably as much as in any profession. There are a few professions—and becoming fewer each year—in which one can be guaranteed a future well-paid position. Economists predict that by 1990 there simply will be too many qualified people for the number of "good jobs" that are available. In an article in *Change* magazine, James O'Toole of the Center for Futures Research at the University of Southern California, stated, "Society may be in the throes of creating a new meritocracy, one composed of the 20% of the population that holds almost all the good jobs in the economy." O'Toole goes on to indicate that this 20% will probably be composed of those possessing large amounts of schooling, and that persons most likely to not be included are minorities, women, and the uneducated. He further states that "the professional and technical category of jobs is the fastest growing segment of the workforce."

If predictions such as these are even minimally accurate, then the choice of science as a future career, by a minority student, does make "economic sense."

However, I would hope that we would not use economic arguments exclusively as motivations for minority students to enter careers in science. There are other, less tangible rewards, which in fact are probably the reasons most of us went into science. We certainly did not choose science as a career because we expected to be wealthy. Why did we choose science? There are very complex reasons for such decisions, but they are usually not economic (although none of us set out to be poor either.)

If I may use myself as an example, when I embarked upon becoming a Physicist I had not thought these things through at all. In my high school in Mississippi, Physics was not even offered, and in any event I left high school in the tenth grade to go to college without having taken any science whatsoever. In retrospect, I think my reasons for going into Physics were quite mundane, perhaps even ignoble. It was primarily a matter of ego. You may not realize it—and let's hope it is not true any longer—but in my day people from Mississippi were considered—to put it delicately—to be less than well educated. Even in Georgia, the state in which I attended college, they believed that Mississippians were none too bright. In a sense I majored in Physics in order to prove to the people around me, and probably myself, that I was intellectually capable of mastering such a difficult and demanding subject. However, once started, I became hooked. Literally, new vistas were opened to me, things which had been mysterious and arcane, or just plain obscure, began over the years of study to make sense. That there were ways of viewing the world of seemingly random events and disconnected phenomena so as to bring some semblance of order, comprehensibility, and even predictability to them was—and still remains to this day to me—an amazing thing.

However, what has been the most profound experience for me as a Physicist has been not the understanding of phenomena, but the perpetual challenge to understand. In research, there is always a new problem, and every breakthrough only initiates another puzzle to solve. Further, it doesn't really matter that other people, past or present, have understood or mastered a particular problem—there is still joy when you master it yourself—when after a great deal of hard work, preparation, and mental anguish it finally comes to you. As we all know, it is an intensely personal experience.

Making advances in knowledge and contributions to the field which are recognized and applauded by one's colleagues is, of course, important and is something one seeks, works for, and appreciates. But this is not the sustaining factor; it is the gravy, not the meat. The meat is the personal engagement with the problem and the taxing of one's mind and emotion to their limits. I am sure it is somewhat akin to what the dedicated athlete feels with retrospect to the taxing of physical capabilities.

Being right or wrong in one's solution to a problem is also clearly important. For one thing, it is an indication of the degree to which the subject has been mastered, but again this is not the essence of the experience. For example, the piece of work which brought me the greatest joy in recent years is considered to be incorrect by most of the Physicists who are experts in my area. Although I still believe it to be a correct solution to the problem, even if it ultimately proves not to be so, that will not make the experience of trying to find the solution any less meaningful to me. It is this personal engagement of the intellect and emotion which has been the most exhilirating aspect of my career as a Physicist. The Noble Prize-winning Physicist, I. I.Rabi, put it this way: he said, "I have always taken Physics personally. I like it better that way. It's my own Physics, within my powers. It's between me and nature."

Somehow. we must find ways to transmit this sense of personal engagement and fulfillment to our students, so that they will be able to sense some of the excitement of what it means to be creatively engaged in scientific research.

Another problem we must give attention to is the image of scientists within the minority community. As long as less than 1% of our students consider careers as research scientists, we will have a very difficult time increasing the number of minority scientists. We have to think of ways to bring to the attention of our students—and their parents—the realistic possibilities of a career in basic science and also a realistic picture of what scientists actually do. This will mean becoming increasingly involved in programs at the pre-college level, high school, and even junior high and elementary schools, and also in activities outside of academia. Joseph Watson points out in a recent article in the book entitled, *Minorities in Science*, and I quote:

> "Because scientific studies are more rigorous, and since science is seen to be more distant from our daily lives and cultural experiences than the humanities and the social sciences, a student, to be successful as a science major must become acculturated in a "distinctive" sub-culture—a sub-culture that is rigidly based on logical and quantitative analysis, the precise use of language and terms, and long, tedious hours of problem sets and laboratory work."

Dr. Watson goes on to point out how critical it is to reach minority youth very early in their academic years—as early as the junior high school level—so that this "acculturation" process can begin. He states: "The junior and senior high school years represent the critical formative years for potential scientists in terms of both career interest and academic preparation." He gives data to show that, overwhelmingly, people who become scientists had indicated interest and shown aptitude by the ninth grade.

We then should increase our efforts to reach minority students at as early an age as possible to give support and guidance to those who exhibit the interest and talent for a scientific career. I am especially pleased to see that the new Resource Center at Atlanta University has this as one of its major goals and would encourage similar efforts by other institutions.

Perhaps all that I have said would seem to have little to do with the title of the talk, "Training Minorities for the Science Careers of the Future". However, my basic position is that this effort will be futile unless we can increase the number of minorities who seriously attempt a scientific career. Furthermore, I believe the important things we can do to prepare minority students for future science careers are the things we should be doing—and should have been doing—to prepare them for existing careers.

The science careers of the future are likely to be those which cut across the existing disciplinary boundaries, which combine or amalgamate approaches from two or more existing disciplines. Research problems, even in the basic area are likely to be motivated by problems which cannot be successfully attacked by the methodology of a single discipline—energy and environmental concerns, molecular level problems in the life sciences, physiochemical problems in the behavioral sciences, and the mathematical and numerical approaches in the cognitive sciences, to mention a few.

If anything, these science careers will require an even deeper immersion in the "sub-culture of logical and quantitative analysis" to which Dr. Watson alluded in the article mentioned previously.

If our students are to be prepared—or even interested—in such careers, we must begin now to attract them to science. I am not advocating that every minority student go into science—and especially into the basic sciences. Not everyone has the interest, talent, or desire to be a scientist.

I submit, however, that there is an enormous amount of untapped and wasted talent and intellectual brilliance within the minority community, and that not only would it be good for society as a whole if the best of these people could contribute to scientific research, but that it would ultimately be good for science. We cannot have too many good scientists, but the professions now are undoubtedly missing a lot of potential contributors because of the lack of significant participation by minorities.

In this respect numbers are important. Talent and native intelligence are no doubt distributed among the minority population in about the same proportion as among the majority population. Therefore, if we are to succeed in attracting the best minds and most creative persons from minority groups into science so that they may make significant contributions, there must first be a sufficiently large pool of people who are interested in the subject enough to pursue it. Therefore, I would argue that we must marshall all of our resources to make our students aware of the rewards—both personal and professional—of a career in science. We must increase efforts to reach those talented students at as early an age as possible so that the necessary skills in Math and quantitative reasoning can be developed. We must devote more attention to reaching beyond academia to reach students and parents to change the image of scientists within the minority community. As James Jay noted in the book I referred to earlier, *Minorities in Science*: "Black newspapers all too often give two-page coverage to a slain narcotics dealer but no more than an inch, if any space at all, to the achievements of Black scientists." He goes on to note that the *Ebony Magazine Success Library* volume which includes successful Blacks, only fifteen Black scientists are included. (Of these, nine were probably included because they are also university or college presidents!)

We must also use more effectively whatever influence we have in professional societies and in state and federal governments to increase the support for programs aimed at minorities in science.

In sum, the preparation of minorities for the science careers of the future has already begun; the challenge is to make sure that we do our part to make the future better than the past.

II. INSTRUCTIONAL STRATEGIES IN THE NATURAL AND SOCIAL SCIENCES

Employing Behavioral Objectives and Drill to Improve Student Comprehension and Retention in Organic Chemistry at Xavier University.
John P. Sevenair (Presented by Joyce Corrington)

Modular System of Instruction for General Chemistry.
Marcelina Velez de Santiago (Presented by Carmen Valasquez)

Multi-Pathways to Learning General Chemistry: PSI Lecture with Piaget-Based Laboratories.
Mary Ann Ryan and J.W. Carmichael, Jr.

Instructional Strategies in Biological Sciences - Videotape Presentation of Basic Biological Concepts.
George W. Miskimen

Individualizing Courses in the Social Sciences: The Blending of A/V Modules and Personalized Self-Paced Instruction.
Frank Brimelow

Teaching Innovations in Applied Economics.
Alice E. Kidder

Modernizing Instructional Capabilities in General Experimental Psychology at Tennessee State University.
Helen R. Barrett.

Planning the Behavioral Sciences Laboratory at Texas Southern University.
Edward C. Powell

EMPLOYING BEHAVIORAL OBJECTIVES AND DRILL TO IMPROVE STUDENT COMPREHENSION AND RETENTION IN ORGANIC CHEMISTRY AT XAVIER UNIVERSITY

John P. Sevenair, Xavier University of Louisiana
(Presented by Joyce Corrington)

With funding by MISIP several experimental activities designed to improve the Organic Chemistry lecture sequence were initiated. Most prominent among these were the provision of improved behavioral objectives and the requirement that each student attend a two-hour drill session once a week. The very large and unwieldy lecture section was divided in two, as well. Extensive evaluations were conducted, and these confirmed the success of the new activities. Responses to an evaluation form given to the students revealed characteristics in the Xavier student body which may be of interest to other institutions with similar problems and objectives.

The term Behavioral Objectives may have a chilling sound to those familiar with certain recent trends in social science research. However, they consist of sheets headed "A student who has mastered (name of a topic in Organic Chemistry) should be able to:" followed by a list of types of problems with examples. Their purpose is to guide studying. The drill sections consist of question-and-answer sessions, solving of sample problems posed by the instructor and frequent short quizzes.

The evaluation is not sufficiently sensitive to distinguish which of the modifications was responsible for the improvement, but that there was an improvement is undeniable. Two measures were used to detect the improvement. First, the grades achieved on final examinations provided by the American Chemical Society were compared with similar grades from earlier classes at Xavier. The study group performed notably better than the earlier classes.

The second objective evaluation measure used was retention. In the academic year 1976-77, 41% of the students who began the first semester passed both that and the subsequent second semester. In the academic year 1977-78, the year that the MISIP activities were initiated, this improved to 64%. The fact that standard exam scores and retention statistics both showed improvement is extremely significant, since one measure can be artificially improved rather easily by the sacrifice of the other.

For a more subjective evaluation, a study questionnaire was given to the students early in the second semester. The students were asked how helpful they found each of the aspects of the course. The traditional features and the new features were evaluated, as were the text and the recommended study aids.

A number of interesting conclusions can be drawn from these student responses. It appears, for example, that the higher ranking students make best use of the elements of the classically taught course: the lectures, the textbook, and independent study. The helpfulness of these declines strongly for the C and D students. These students find most helpful those elements of the course which guide their studying most specifically. The drill sections were the most helpful component for the D students compared with the lecture and independent study. For example, they were the least helpful for the A students. The recommended nomenclature book, a programmed text, received relatively high ratings from the lower ranked students.

A question on the helpfulness of studying for the various classes of exams also produced interesting answers. The A students found studying for the final examination, which covered all of the material in the course, most helpful. These students apparently have the ability to relate materials from different chapters, and use studying for the final to do so. The D students found studying for the weekly short quizzes most helpful; attempts to correlate different concepts are apparently difficult for these students.

Since many Xavier students come from deprived backgrounds and since many C and D students in Organic Chemistry go on to responsible positions in pharmacy, medical technology, and even medicine, the aids these students find helpful are, and will, remain an important part of our courses.

MODULAR SYSTEM OF INSTRUCTION FOR GENERAL CHEMISTRY

Marcelina Valez de Santiago, Catholic University of Puerto Rico-Ponce
(Presented by Carmen Valasquez)

Chemistry 105-106 is a core course of the B.S. curriculum at Catholic University of Puerto Rico. It is a terminal course for students majoring in Physics and Mathematics, and an introductory course for those majoring in Biology, Chemistry and General Sciences. Studies conducted since 1973 show that the attrition rate in this course has been increasing greatly. In an attempt to deal with the problem several approaches were tried, among which were: appointment of a coordinator for the course, formulation of instructional objectives, provision for retaking the partial exam in which the student obtained the lowest score. Since the textbook being utilized was in English, summaries in Spanish for each chapter covered were prepared, exams were offered every two weeks, and optional drill sessions were offered. Although these approaches were tried, attrition kept increasing. A committee appointed to evaluate the situation suggested that the previously tried approaches be integrated and combined with a change in methodology.

The system of instruction proposed took into consideration institutional policies such as: compulsory attendance, completion of course requirements within one semester, and grading according to the university grading system. The proposed program included preparation of modules, programmed lessons in Spanish with scientific terminology both in Spanish and English, and slide-tape lessons on mathematical applications of chemical concepts. Establishment of a learning center, implementation of a student tutorial program, and provisions for different modes of evaluation including quizzes, make-up quizzes and comprehensive exams were also included. Since the institution could not afford the expenses of implementing the program, a proposal was submitted to MISIP. The proposal was approved and funds were granted for 3 years starting June, 1977.

The preparation of materials was initiated during the summer of 1977 and the program was implemented during academic year 1977-1978. The experimental group consisted of 49 students that were classified as, average by the freshmen placement office according to College Board Exam results and High School Index. The academic performance of the experimental group was compared with that of students of higher entrance index (control group I) and that of students of lower entrance index (control group II). Both the experimental and the control groups covered the same material. The control groups used the traditional lecture-discussion strategy while the experimental group used the modular system. For the purpose of comparison, five tests were administered: diagnostic exam, mid-term and final examinations for the first semester, and mid-term and final examinations for the second semester.

Although the lowest mean for the diagnostic exam corresponded to the experimental group, the results for the mid-term and final exams for the first semester and the mid-term of the second semester indicated that the performance of the experimental group was better than that of the control groups. The results for the final exam of the second semester showed that the experimental group performed as well as sections of higher entrance index (control group I).

Final grades in both semesters were also compared. During the first semester, 89.8% of the experimental group passed the course with an average grade of 79. Compared to the control groups, it was the highest percentage of pass and the highest average grade. During the second semester 83.7% of the experimental groups passed the course with average grade of 77. Compared to the control groups, it was the highest percentage of passed, although the average grade in control group I was two points higher.

A follow up study was conducted with General Chemistry students of 77/78 who enrolled in Analytical Chemistry during the first semester of 78/79 academic year. The experimental group had a higher percentage of students obtaining the same or higher grades in Analytical Chemistry as in

General Chemistry (70% for the experimental group vs. 32% for the control groups). Results seem to imply that the new methodology, besides contributing to improve the academic performance in General Chemistry, gives the student the opportunity to master the fundamental concepts and to improve his performance in upper level chemistry courses.

At the present time, one fourth of the total number of General Chemistry sections are subjects during the second year of the project. Preliminary analysis for the semester of August-December, 1978 seems to indicate the same trend in grading and attrition as in 1977/78. The experimental group also covered one chapter more than the control group.

MULTI-PATHWAYS TO LEARNING GENERAL CHEMISTRY: PSI LECTURE WITH PIAGET-BASED LABORATORIES

Mary Ann Ryan and J.W. Carmichael, Jr.
Xavier University of Louisiana

Recognizing the importance of providing a good foundation in General Chemistry for science majors, the Chemistry Department at Xavier University of Louisiana has placed much emphasis on finding ways to improve student performance and reduce attrition in the course. Over the past six years a variety of instructional strategies has been developed. To deal with the problem of great diversity in the mathematics, reading, and science preparation of the students, the lecture course is conducted in a modified PSI format. To improve analytical reasoning abilities, an investigative (Piaget-based) laboratory program has been developed and implemented.

The General Chemistry lecture course is a self-paced, individualized sequence designed to obtain pre-specified objectives. The course, a modification of Keller's Personalized System of Instruction, has been used in General Chemistry sections at Xavier University since 1972. The basis for progressing through the sequence is a General Chemistry Handbook developed by the authors. This specifies in detail the learning objectives for each module. Students proceed at their own pace, and are required to demonstrate mastery level performance (a grade of at least 90%) on each module test.

Three distinct pathways are provided for achieving each set of objectives: regularly scheduled live lectures, audio tapes for use at the student's convenience (designed specifically to assist those having reading comprehension difficulty), and reading references in a standard textbook. The course also includes required basic mathematics modules carrying chemistry credit. These immediately precede the chemistry module in which the mathematics skills are to be applied. Mathematical difficulties fall into two categories: manipulative skills and reasoning ability. The first was removed by providing calculators, thus allowing time for more stress on basic mathematical concepts, including reviews, within the structure of the chemistry course. The inclusion of the basic mathematics modules and the three distinct pathways for learning content were the result of a decision by the Chemistry Department to try to find ways of teaching chemistry without necessarily correcting all existing reading and mathematical deficiencies at the outset.

Students who do not complete the material of the course in two semesters are permitted to extend the course into a third semester without penalty. Thus, students with deficiencies can take the extra time they need to overcome them, while students who are well-prepared can proceed at a sufficiently rapid rate to prevent loss of interest in chemistry.

Evaluation of the PSI course vs. traditionally-taught course indicated that students in the PSI course scored seventeen percentile points higher on the ACS General Chemistry Examination than did students in the traditional course. Students in the self-paced course also scored higher on a test for retention of general chemistry content. A slightly higher percentage of students complete the course with a passing grade under the PSI system than under the traditional system (60% vs. 50-55%); however, this difference was not sufficient to justify continuation of the course on this basis alone. The increased performance and retention of content for those completing the course were the outcomes of significance. Surveys of student attitudes since the PSI course was initiated have consistently shown that 70-80% of the students prefer this type of course to the traditional type. A majority of students believe that they work harder and learn more than they would have in a traditionally taught course.

A new laboratory program based on the learning theory of Jean Piaget has been developed over the past two years at Xavier University and is now in use for all sections of General Chemistry Laboratory. Some recent studies of American college students have indicated that a sizeable proportion of students do not have the ability to reason abstractly in the fashion described as formal operational by Piaget. It has been suggested that students who cannot do so would be more likely to grasp the concepts of a science which requires a great deal of formal operational thought (as chemistry does) if concrete problems and meaningful inquiries are used to lead the students into abstract thinking. Therefore, we have written laboratory experiments which lead the student from concrete, observable phenomena to abstract principles, rather than providing the theoretical background first and simply having students verify the theory (as in traditional experiments.)

Our experiments follow the learning cycle suggested by Dr. Robert Karplus of Berkeley— exploration, invention, and application. In the exploration part of the experiment students are given an opportunity to explore a particular topic, become familiar with it, and raise questions about it. For our experiments, the students were given specific instructions to follow in this part as they became acquainted with a system. In the invention part of the experiment, the students are asked to look for patterns in their data, make generalizations about it, and plot data where applicable. The variables and their relationships are highlighted in a group discussion with the students. These activities lead toward the invention of concepts.

Finally, in the application part of the experiment the students are asked to extend the basic concepts in some way. In some experiments the students are asked to take the concepts they developed and make predictions of some sort on the basis of them. This might involve calculations and/or answers to questions. In some cases the application takes the form of an open-ended component to the experiment, in which the student is asked to investigate, in his own way, an area closely related to the one he studied in the first two parts of the experiment.

Our overall approach to the laboratory course is best described by the term "guided inquiry." Informal evaluations of the program thus far have indicated that student interest is greater and performance better than that observed in traditional laboratory sections.

INSTRUCTIONAL STRATEGIES IN THE BIOLOGICAL SCIENCES - VIDEOTAPE PRESENTATION OF BASIC BIOLOGICAL CONCEPTS

George W. Miskimen
University of Puerto Rico, Mayaguez

Videotape presentation of basic biological concepts is a proven and potent tool for laboratory and classroom instruction. During times of increasing instructional costs it becomes essential to seek ways to reduce these costs yet maintain quality of instruction. Videotape instruction can serve both functions - reduction of instructional time and materials outlay. While at the same time, it provides improved learning opportunities by combining the use of high-quality A-V material with live demonstrations presented by team-teaching professors specializing in various subject areas. "Close-up" details of experiments and demonstrations can easily be seen by each student, regardless of seating arrangements, and scheduled replays further reinforce learning possibilities for less-advantaged students. In the case of the University of Puerto Rico at Mayaguez, where 1200 undergraduate biology majors as well as 1000 other students are served, the first year basic biology laboratory courses were targeted under our Video Instructional Pilot Program.

Basic equipment needed to successfully complete such an undertaking can be comparatively inexpensive or it may be highly sophisticated. Either type can be effective. Minimum equipment needs include a TV camera for live demonstrations and for copying slide, film strip, or overhead projector material, a 16mm graflex TV motion picture projector for transcribing films directly onto videotape, a videocassette editing recorder/player, some form of lettering system, and, of course, a supply of videocassettes. If a closed circuit TV system is already available on campus, as it is on ours, facilities such as video typewriters, switchers, etc., make production much easier.

Production is perhaps the most important aspect of videotape presentation. There must be understanding and coordination between professors supplying subject material and studio technicians in whose hands lie real success. It is essential that academic personnel fully understand the mechanics of TV production and be familiar with the limitations and capabilities of equipment that is to be used. It is also necessary to be aware of the various visual aids sources.

The first step in videotape production is outlining each individual unit of the program and evaluating which portions can be completed with "canned" visual aids sources such as films, slides, and film strips and which parts require "live" demonstrations. When using films and other commercial visual aids materials, it is generally necessary to observe copyright laws. A letter requesting permission and the terms or conditions should be sent to suppliers.

After visual aids materials are assembled, these are reviewed and a provisional audio script is prepared with notations listing the required visual images. If, for example, part of a movie represents an effective way of transmitting information, the movie is taped onto a working tape along with its soundtrack. Film strips, slides, and live demonstrations are also taped onto working tapes. It was found desirable to use closeup shots wherever possible to insure visual clarity. Preparation of an audio narrative on tape recorder cassettes is then completed so that a time base can be established for synchronization with the video image.

After assembly of the various video and audio components on working tapes, the most critical step of final recording and editing can begin. Using the editing recorder/player, material from the working tapes is assembled. Captions printed by the video typewriter are superimposed upon the video image during assembly. Technical sophistication is almost unlimited; if time is insufficient to complete a narration, videotape techniques permit repetition or stretching out that portion of the image, microscopic images are possible, images can be superimposed, and so forth.

The video image is first incorporated on the final master tape followed by the audio. Using the previously prepared tape recorder cassettes, our technique has been to play the tape cassette into the headphones of the narrator and, as the video image is observed, to dub in the final narrative orally. If changes or corrections are needed, the editing recorder/player can be used to insure precision placement of changes. Once the final master tape has been completed, additional copies can be made as needed. Two audio channels are available in many editing recorder/players so, in our case, one channel was used for the final Spanish language narrative while the other retained English language "working" narrative although it could also be used for final English narrative.

There are 18 videotape laboratory programs available. Each unit occupies approximately 45 minutes and is presented at regularly assigned hours as well as a number of additional showings for students who feel the need for additional learning reinforcement.

The Basic Biological Concepts videotape presentations are evaluated on a continuing basis. Two methods are used: 1) student response questionnaires concerning opinion of video versus conventional instructional methods, and 2) objective tests scores on uniform tests given to sections taught "live" versus those taught by videotape.

Under our system, students from classroom sections are randomly dispersed into lab sections which are graded independently, so it was possible to compare both videotape versus live lab-trained students and also classroom performance of each training group. Lab performance of videotape trained students was significantly superior at the 0.01 level while classroom performance was higher, but not significantly so. If labs and classroom grade percentages were weighted equally (actual weight is 1:3), then classroom performance of videotape lab-trained students would also have been significantly superior.

Videotape presentation classrooms are of 35 student capacity. Two 25 inch, commercially available, color television monitors per room are placed at a level of 5 feet above the floor. Booster audio amplifier interface between the campus-wide closed-circuit TV coaxial cable and the monitors. Tapes are played from the central studio as needed.

A large-screen TV projector for use with 10x10 foot screens in auditorium facilities was considered originally, but it was felt that individual TV monitors placed in a number of separate rooms would provide more flexibility and would result in less disruption in case of breakdown. In addition, full room light can be used with conventional monitors.

In general, response to the video-tutorial approach has been extremely favorable. A very small number of students regarded the method as too impersonal. Much student time was saved in learning conceptual material and the opportunity for repeated viewing was very favorably received. Not unexpectedly, most objections came from some faculty members who perhaps felt that they were being replaced. We recommend, therefore, that when establishing similar programs, it be emphasized to staff that faculty time freed by the videotape approach could be used to participate more actively in advanced courses or in individualized instruction.

INDIVIDUALIZING COURSES IN THE SOCIAL SCIENCES: THE BLENDING OF A/V MODULES AND PERSONALIZED SELF-PACED INSTRUCTION

Frank Brimelow, Voorhees College

Several years ago, Voorhees College, a small, predominantly black college in South Carolina, won a MISIP grant for the purpose of improving instruction in the Social Sciences. A principal component of the improvement program was the establishment of a social sciences auto-tutorial learning laboratory, which was designed to allow students to work at their own speed, with some additional tutoring if needed, on specially prepared A-V modules.

Voorhees College, which maintains an "open admissions" policy, serves students who come mainly from rural areas and small towns within the state of South Carolina. Many are ill-prepared for college work, and those who are the least prepared often read only at eighth or ninth grade levels. Our kind of student body, it was expected, would derive distinct advantages from auto-tutorial A-V modules for a number of reasons. In the first place, students with serious literacy problems, because they cannot take notes quickly and accurately, have difficulty in traditional lecture courses. Under this new teaching method, however, a student working at his or her own pace when doing auto-tutorial A-V modules in the laboratory would have time to improve grammar, spelling, and other writing skills. Secondly, since many of our students come from homes where there is little exposure to things sometimes designated as "cultural", it was expected that, given the wealth of A-V materials now commercially available, A-V modules might provide a substitute for the multitude of visual experiences that young people from more educated, wealthier families receive as a normal part of their home environment.

Accordingly, a social sciences laboratory was established. It contained twelve semi-private carrels, nine of them equipped with Dukane filmstrip/cassette tape machines, and three with Caramate slide/cassette-tape machines. In the fall semester of 1977 A-V modules were introduced as central requirements in two courses, World Geography 231 and European History 432*. Laboratory assistants—students of high grade-point averages and mostly seniors—were trained to use the machines and to assist other students with auto-tutorial A-V modules. The laboratory was open thirty hours each week, students being encouraged to come in at their own convenience to work on the modules. In the spring semester of 1978 auto-tutorial, A-V modules were incorporated into yet another course, Introduction to Sociology 231.

The organizational details of the three experimental offerings are worth recording. World Geography was typical of the three. It was a second year course with an enrollment of 32 students. Most were sophomores, but the class did contain a sprinkling of juniors. One part of the course was fairly traditional. All course participants attended three normal, one-hour lectures each week. They took four tests during the semester and these scores constituted 45% of the final grade. The most important requirement from the point of view of this paper, however, was that all students were expected to do five auto-tutorial A-V modules out of a choice of eight. The modules were, of course, done in the Social Sciences Laboratory with some help from lab assitants. The average student needed approximately four hours to complete each one. He was given a single sheet or a small pamphlet which served not only as a guide to him in his study of the filmstrip or the slide-set, but which also tested his understanding of these A-V materials by means of searching questions. Most questions demanded a full paragraph for an answer; some, particularly those towards the end of the module, required essay-length answers. Once a student became proficient with the machines, he could switch the filmstrip, the slides, or the cassette-tape back and forth to select the information he needed to answer the module questions. Students could use dictionaries, grammar books, encyclopedias, and other reference tools available in the laboratory. On completing a module, students handed them in to the instructor and they were graded on the basis of 100 points. Taken together, the five modules constituted 55% of the total grade.

---

*Support for the development of history courses was provided by Lilly Foundation grant.

In all three courses students filled out an extensive evaluative instrument at the end of the semester. Student responses indicated that they both enjoyed and profited from the modules. The maximum negative response to the modules came in the World Geography course where six out of twenty-three students opted for the answer "I would have learned more without the modules—with just traditional lectures and regular tests". In Introduction to Sociology only two students out of 25 chose this negative response, and no students in European History chose it. On the open-ended parts of the questionnaire students often wrote in comments such as "I got a better understanding of the World Wars" or "I found them very educational".

To some extent this end-of-semester evaluative questionnaire was redundant, because the instructor had already learned from informal discussions with students that they enjoyed modules and thought them valuable. The most interesting part of the questionnaire, therefore, was the question the instructor inserted in an attempt to determine just exactly why or how course participants benefited from this teaching technique.

The question was entitled Modules and the Learning Process, and responses to it were based upon the Likert scale. An analysis of the results suggests that one reason why students value this learning method is because it gives "mental images of some of the things mentioned in lectures or elsewhere". Some 49 students agreed or strongly agreed with this proposition, while only two students disagreeed. This finding suggests that the old concept of 'cultural deprivation' may not be completely invalid after all, that the use of A-V modules does for Voorhees students what years of browsing through National Geographic and Time magazine does for youths from more advantaged homes—it gives them mental images to which they can attach words.

A second very tentative conclusion one might reach is that having a sense of being in control of the learning process is important to our students. As many as 51 agreed or strongly agreed with the proposition that doing modules was interesting because "you could control the learning process, switching the filmstrips and cassette-tape back and forth, taking notes and answering questions at your own pace". Only three disagreed with this. Thus, we may be dealing at Voorhees with students who are alienated from the learning process. If this is true, any steps we can take to create in the student the feeling that he controls his own learning process and also, to some extent, the learning environment, will bring improved results.

Once A-V modules had become established as an instructional method, the instructor blended this technique with the technique of Personalized Self-Paced Instruction (PSI). It was decided to introduce PSI modules along with A-V modules in a sophomore-level course, Ancient and Medieval History. This was a small group of five students, three of whom were history majors intending to graduate at the end of the year.

In most respects the PSI technique used was orthodox. The contents of the course were divided into eight units or modules. Each module was based upon a section of the course textbooks, *The Civilization of the Ancient World* by Chester W. Starr. For each module the instructor prepared a guidesheet for student use. These guidesheets consisted of identifications and topics for paragraphs and essays. The mastery quiz given to the student when he had studied the appropriate readings in the text were simply taken directly from the module guidesheet.

In two ways, however, the teaching method used differed from prevailing PSI techniques. First, no student proctors were used. Since the class was small, there seemed no point in devolving some of the teaching and testing functions onto trained student-assistants; the instructor coached students and administered mastery tests himself throughout the semester. Secondly, and perhaps more importantly, the principle of mastery learning, so dear to the hearts of PSI devotees, was partially modified. When students take a unit test in a standard PSI course they receive an A or temporary F. But in this course A, B, and temporary F were the grades assigned. This meant that the end of the semester a student would generally have a mixture of A's and B's to his credit, rarely a line of A's.

Even with a partial abandonment of the mastery principle two students out of five did not complete the course. Significantly, both of them finished their A-V modules but fell short in completing regular PSI modules. At the end of the course, the participants were asked to fill out questionnaires. Student response to the course and the teaching methods was definitely positive. The course was described as "interesting" and "an exciting learning period," and the methods used were described as "a good way to learn," and "a good procedure." However, students did seem to think that there was too much work in the course. One said he would not advise a fellow student to take more than one PSI course per semester. Two students suggested that the method of testing was rather lengthy and exacting. As a result of these observations the course is being modified slightly.

Overall these experiments have been received with great enthusiasm. Work is proceeding to adapt this blend of techniques to other courses.

Since the expiration of the MISIP grant, this work has been carried on with financial assistance from the Lilly Foundation. Development of History course materials was accomplished through the support of Lilly Foundation grant.

TEACHING INNOVATIONS IN APPLIED ECONOMICS

Alice E. Kidder
North Carolina A & T State University

The penetration of minority scholars into the discipline of economics has lagged behind that of many scientific professions. It is alleged that the quantitative nature of the field deters the social science undergraduate, and the abstractions of economic theory compete at a disadvantage with the more policy-relevant fields of law, sociology, or business. To counteract these tendencies, the Economics Department of North Carolina A & T State University has introduced several techniques to attract and retain students in the field. I shall describe several approaches, and report on the outcomes of:

1) a Learning Resource Laboratory to provide tutorial instruction in quantitative areas
2) expanded curricular offerings in quantitative methods, and
3) on-the-job learning opportunities for students to work with faculty on funded research projects in applied economics

Under a grant from the National Science Foundation, the Economics Department set up a tutorial center, staffed with students and faculty prepared to assist students with quantitatively demanding courses: econometrics, statistics, operations research, calculus, and intermediate economic theory are principal problem areas. Students can use the Lab any time between 9 a.m. and 5 p.m., and may opt for a student tutor or a professor other than his/her instructor. Students raise questions about the reading assignments, homework problems, or exercises, and may be given programmed instruction materials. In addition, A-V materials (tapes, slides, video cassettes) are available as self-paced instruction. At least thirty students are monitored in the Lab each day and usage is voluntary.

To test the effect of the Learning Resource Lab, the faculty studied the impact on GRE scores. Interestingly, in the era following the introduction of the Lab, GRE scores in verbal areas did not gain, but there was a statistically significant increase in performance on the quantitative testing. During the period 1965-72, the average was 403 points; during 1973-75 the average rose to 442. The upper range also improved. Another test was later performed to see whether the Lab usage *per se* contributed to improved GRE performance. A single equation model was used to predict (Q) the scores on the quantitative aptitude test, using as predictors GRE Advanced Aptitude Test (A), grade point average (G), Learning Lab usage (L), and sex (S). The results are given in Equation (1).

$$(1)\quad \underset{}{Q=116.45+\underset{(18.95)}{20.44G}+\underset{(0.19)}{0.50A}+\underset{(22.34)}{19.07L}+\underset{(21.84)}{29.36S}}\qquad R^2=.21\qquad \text{(Evans and Jeong)}$$

Even taking into account the effects of other contributing factors such as sex and GPA, the positive effect of the Learning Lab is evident, as it statistically improves performance on balance nineteen points and, since the effect interacts with GPA, may possibly account for as much as sixty points, or approximately a fifteen percent increase. These encouraging results have led the A&T administration to continue funding beyond the duration of the NSF grant.

There are few attractive economics jobs for students who hold only a baccalaureate degree in the field. A&T encourages students to apply for graduate training, and to prepare them for the rigors of graduate school, offers the students econometrics, quantitative analysis, and operations research electives in addition to required courses in calculus, matrix algebra, statistics, intermediate micro and macro theory, and a research methods seminar. Students from the program have gone on to complete Ph.D. course requriements at Harvard, M.I.T., U. of Illinois, U. of Kentucky, and other graduate schools in economics. Students pass the challenge of graduate training in economics from one collegiate generation to the next, and successful doctoral program completions give evidence of satisfactory undergraduate preparation.

With a group of undergraduates trained by their junior and senior years in economic theory and quantitative methods, faculty of the department have been able to involve students as paid research assistants on funded projects. Students soon learn the relevance of economic theory when preparing cost/benefit analysis for the Environmental Protection Agency, or evaluating the economic impact of transportation projects for the Urban Mass Transportation Administration. Theory and practical relevance blend in a learning experience which pushes the students to the limits of their academic growth. Undergraduates need closer supervision than graduate assistants, but the payoff in demonstrated skill development is profound. Students with a track record in funded research can more easily obtain subsequent employment with the government, with consulting firms, or with management firms. Faculty are given released time with which to conduct the research projects, and students may receive independent study credits for their research work. Faculty/student workshops presenting research results enhance the reputation of the department.

These programs can, and are, being implemented on many minority campuses today, and it is hoped this presentation will convince other schools of the feasibility of expanded programs in applied economics.

MODERNIZING INSTRUCTIONAL CAPABILITIES IN GENERAL EXPERIMENTAL PSYCHOLOGY AT TENNESSEE STATE UNIVERSITY

Helen R. Barrett, Tennessee State University

When the MISIP grant opportunity came to the attention of Tennessee State University in 1971, all of the science departments were briefed on the guidelines. It was clear that this was an important opportunity for General-Experimental Psychology at Tennessee State. Although the department courses listed in the catalogue were representative of the various disciplines in psychology, including among them a year of Experimental Psychology and Physiological Psychology, lack of facilities made it virtually impossible to carry out experiments and demonstrations which were typical of the various basic and applied experimental areas such as learning, physiological perception, and human performance. For these reasons, we felt that our primary focus should be to strengthen our present program in General-Experimental Psychology, rather than to head in the direction of highly innovative approaches. Two basic criteria served to guide our planning and eventual implementation of the program supported by MISIP: first, a significant number of students would be benefited, and second, the improvements should be thought of as permanent in nature. A more specific content-related goal was the aspiration that the new programs would greatly enhance our ability to train students in both the technical and conceptual skills required to employ the methods of science to questions of psychology. Thus, we spent considerable time selecting content areas which we felt would have high intrinsic interest and would appeal to a broad cross-section of students.

The program was designed to provide a variety of representative "hands on" experiences to supplement our standard "lecture-book" approach with exposure to contemporary behavioral research methods. Specifically, funds were used to support the various activities.

I. Personnel

- a. *Faculty.* The planning of laboratory facilities and the reorganization of courses was facilitated by a Ph.D. level experimental-physiological psychologist, hired initially with Foundation funds. Presently, an M.A. level laboratory manager, hired with University funds, is responsible for preparations and demonstrations, and students use of the laboratory.
- b. *Students.* Student laboratory assistants, initially hired with NSF funds (and presently by the University), have worked in the laboratory since its inception.

II. Research and Training Laboratories and Accessories

- a. *Experimental Psychology (Learning).* A full-scale laboratory was established to accompany the Learning course. It is equipped for experiments, demonstrations, and student projects in animal and human learning. Major equipment procured includes animal housing facilities, operant conditioning chambers, and devices for human learning, such as biofeedback equipment and memory drums. A part of this course was an equipment construction program in which students built laboratory apparatus used to run experiments.
- b. *Experimental Psychology (Perception and Human Performance).* A laboratory to accompany this course was equipped for demonstrations and experiments in this area, including for example, reaction-time, audiometry, and the measurement of visual illusions.
- c. *Physiological Psychology.* The laboratory for this course is designed for training in neuroanatomy, small-animal stereotaxic surgical techniques, and behavioral testing of physiological manipulations.
- d. *A-V Aids.* Films, slides and tapes were acquired to correspond to the above content areas to supplement classroom lectures.

e. *General Psychology and Senior Project.* Equipment for the above courses is drawn upon for demonstrations to General Psychology students, and for individual research projects by students enrolled in the required Senior Project research course.

III. Colloquium Series

a. *The Psychology Colloquium Series* was established to compliment formal course work with outside speakers in various research areas. Programs were publicized throughout the University, as well as in the Nashville psychology community.

Results and Evaluation. It is a credit to the design of our program and the co-operation of the administration that the improvements are long-term in nature, affect a large number of students, and are used extensively. Nothing is sitting unused in closets. Further, our equipment and A-V aids tend to be standard, modern devices, not so highly specialized as to appeal to the interests of a limited number of students and faculty members. The laboratory exercises and demonstrations are representative of what can be done with our resources. We are now in a position to draw upon our holdings to devise other student exercises, demonstrations, and individual projects as our courses evolve from year-to-year. The range of our facilities permits us to encourage individual student research projects in a variety of areas. Since 1973, each semester we have had Senior Projects and theses run in our laboratory in the areas of learning, chemical brain stimulation, bait-shyness, biofeedback, and short-term memory.

All of the above-mentioned programs were found workable with the exception of the equipment construction program. The large investment in faculty time for the necessary supervision and guidance (for 30-40 students) was not justified by the educational impact. The Psychology Colloquium Series existed for three years of Foundation support. While no funds are currently available for this kind of regular activity, we have established a mechanism and precedent for such a series, which can be continued on an occasional basis if funds permit.

Several observations are indicative of the impact and success of the program: 1) A rating-scale type questionnaire to evaluate the revised course in Learning indicated clearly that students felt that laboratory exercises facilitated their grasp of textbook concepts and made the course more interesting. 2) As the first full-scale undergraduate laboratory among the Nashville universities, it is a source of pride among students, and has been the basis for contacts with other departments in the city. 3) The number of majors deciding to attend graduate school in experimental psychology remains small, however, we have effected the exposure of all majors in the department (about 70% of whom go to graduate school in some branch of psychology), as well as some non-majors to scientific approaches to behavior. 4) The program has promoted interdisciplinary exchanges on our campus since we have attracted non-majors to some courses, supervised interdisciplinary theses, and increased contact with faculty in other science areas. 5) The program has been the basis for two subsequent research and training grant applications, both of which built upon the facilities and courses supported by MISIP. 6) The careful selection of equipment resulted in apparatus which has proven to be versatile, (e.g. the modular programmable biofeedback device which is used in every facet of the program). 7) The program has been continuously active since 1973. When NSF funds were exhausted in 1977, the University assumed certain financial responsibilities (laboratory manager and supplies) to permit program operation, and has continued to provide and increase laboratory space.

PLANNING THE BEHAVIORAL SCIENCES LABORATORY AT TEXAS SOUTHERN UNIVERSITY

Edward C. Powell, Texas Southern University

THE SYSTEMIC CONTEXT

The Behavioral Sciences Laboratory is conceptualized within a systems perspective. This perspective provides a meaningful framework for interrelating student, programmatic and societal needs and provides a system for selecting solutions to complex problems.

Texas Southern University, after careful study of the environments within which it exists and serves, sought and obtained a new mandate from the State of Texas: serve the urban environment through effective programming. The nature of the emerging environment seems to demand a new specification of basic education. We have conceptualized our version of the new basic education in three interrelated parts: process, thematic specialization, and integration.

The process skills include, but are not limited to, the ability to conceptualize the essential dimensions of ill defined situations and to construct meaningful models. Integration skills include the ability to apply theoretico-empirical knowledge to improve the human condition. Thematic specialization skills represent one's abilities to follow signs to problem solution no matter what traditional departmental lines they cross.

Our present thinking is that the implementation of this model would increase the life chances of our graduates and at the same time more effectively serve the general societal interest by providing new professionals with skills appropriate in dealing with unique complex problems.

Our assessment of the state of the environment and informal assessments of transitional probabilities to new states reflecting an increased fit between graduates' skills and societal needs indicates that:

1. The inertia of organizational structures and traditional curricular models are so strong that new ideas may not only be rejected but also taken as proof that the initiators are outside the mainstream and, therefore, need not be seriously considered.
2. The society will neither give less than due consideration to science oriented ideas nor fund traditional ones without expecting major reorientations to fit new needs.
3. The funds to support the type of curriculum design suggested are unlikely to be available in the required amounts to do the renovations demanded with the speed the developing situation suggests.

THE LABORATORY

The laboratory supports the general model discussed above and the traditional programmatic environment. The objectives of the laboratory are:

1. To provide an academic support facility where undergraduate students might use A-V materials on individual and small group bases in economics, psychology, and sociology, and
2. To provide a data analysis laboratory to improve quantitative and analytical skills among socio-behavioral sciences students.

In order to fit the laboratory into our over-all model design, the following criteria were established:

1. The laboratory must be both a physical space designed to support the objectives and a process of knowing and doing not limited by space considerations.
2. The principle of flexibility must dominate all other considerations so that responsiveness to new conditions will be facilitated.

In the A-V component, study carrels may be arranged into several designs depending on space and instructional strategy, or moved to new facilities we project in 1981. The software is relevant for at least three disciplines.

In the data analysis component we had the choice of short term advantages or long term potential. One set of minicomputers had one high level language, very definite limits on simultaneous hands-on use and few growth options. Another set had multiple, high level languages, the potential to expand the number of users, change operating systems and select options which facilitate growth. We chose from the latter group. The basic hardware is a DEC 11/34 computer. RT-11 is the operating system. The high level languages are FORTRAN and BASIC.

The students being served are largely in the lower division of the socio-behavioral sciences. The upper division students served are primarily in statistical or other quantitative courses. The average number being served will increase from the present 350 per term as additional hardware and a wider range of application programs become available.

PROJECT EVALUATION

The Behavioral Sciences Laboratory is operating within the limits and at the potential expected of the planned, first-stage development. While no formal evaluation research has been completed, the demand for longer hours of services, for more terminals, for other peripherals and for the mini-library donated by faculty and students indicates positive evaluation. Additional hardware would allow us to support more students and to interface experimental psychology and the computer.

CONCLUSION AND RECOMMENDATIONS

The systems perspective is effective in both planning and implementation of projects. We did not have the funds to do what we know needs to be done. However, the development of an over-all model facilitated our understanding of what might be done with modest funds to achieve over-all goals. It is recommended that:

1. more of us utilize the systems approach to programmatic development,
2. the short-term, dead-end development advantages be traded-off in favor of modular growth potential, and
3. NSF continue this program and develop others which support high risk alternative approaches to ways of learning.

III. COMPUTER-ASSISTED INSTRUCTION

Using the Computer in the Teaching of Science.
James D. Beck

Increasing Success in and Undertaking of Science among Urban Minority Students (Project ISUS).
Carl Polowczyk

Computer-Assisted Instruction in General Chemistry.
Alex Bonilla and Manuel Gomez-Rodriguez

Scientific Academic Computer Planning Process.
John Garner

Innovative Instructional Uses of Computers at Jackson State University.
Jesse C. Lewis

Interactive Computer-Assisted Drills and Exercises in Science Courses at Hostos Community College.
Amador C. Muriel

USING THE COMPUTER IN THE TEACHING OF SCIENCE

James D. Beck, Virginia State College

Students enrolled in our two-semester sequence in general chemistry at Virginia State College represent diverse backgrounds, interests, and abilities. They are drawn from a number of different majors, including agriculture, biology, chemistry, geology, home economics, mathematics, microbiology, and physics. A significant fraction of the enrollees are interested in medicine and other health-related careers. The students in these chemistry courses also vary widely in their scientific and mathematical backgrounds and abilities; some ten to fifteen percent of them had no chemistry in high school and the quality of the high school courses taken by the others is questionable. When we administered the ACS-NSTA standardized examination in high school chemistry to students entering the general chemistry sequence, the highest score recorded was at the fifty percentile level while the mean and median scores were just above the ten percentile level.

Faced with this very diverse group of students, many of whom are not adequately prepared for a rigorous science course, our basic approach has been to provide students with a variety of alternative learning modes and extra opportunities to master the course material. We have made the computer an important part of this program and hope to enlarge its role in future refinements. Our experience indicates that the computer can play a useful role in instruction in chemistry and undoubtedly in other science areas as well. With the reduction in cost of computer capability and the increasing prevalence of microcomputers, computers should be playing an increasing part in our instructional delivery systems.

Our goal in this general chemistry program is to make available to our students a wide spectrum of different ways to learn chemistry in the hope that some of these will meet the needs of all of our students. The variety of materials and methods also allows students who are poorly prepared to engage in extra activities to help them master the material.

We have elected to retain the traditional components of our general chemistry course–textbook, lectures, recitation sessions. The laboratory continues to operate as a separate course and will not be included in this discussion. To the traditional course items, we have added a study guide that is published as a companion to the textbook, sets of performance objectives, slide/tape and filmstrip/tape programs, individualized computer-generated problem sets, voluntary practice sessions, and computer programs. Students are required to use some of these, but they may select the ones that they wish to utilize and may engage in more than the required minimum number of activities. They may also make use of the traditional course components, of course.

The computer is used to generate the individualized problem sets for student use. Most of these are now being done in batch mode, with the computer simply selecting questions at random for inclusion on the student's set. The sets are then distributed in classes, the students may answer the questions and turn them in for grading. Next year we would like to generate the questions and answers in a different manner and to use the computer for grading the student responses. We also want to make more use of these problem sets for diagnostic purposes.

The same computer program that generates the individual problem sets will also produce individualized quizzes. Again, we are planning to alter our operation next year so that the quizzes can be generated by the computer and could be completed at a computer terminal. This will make repeatable testing possible.

We have also been using the computer in an interactive mode for computer-assisted instruction (CAI). Currently we have about forty programs that we use throughout the course. Most of these are single concept and the majority are of the drill-and-practice type. A few are tutorial, simulations, or just problem generators. For the most part they are not of a sophisticated nature but do provide additional practice and, to some extent, tutoring on basic concepts. These are all written in the BASIC language with the exception of a CAI program on balancing redox equations by the ionelectron method which is written in Coursewriter. We plan to expand our collection of programs in this category now that additional software of this type is being marketed.

We have not done a definitive study to ascertain whether or not students are really learning more, better, or easier under our alternatives program than they do in traditional lecture-recitation courses. We have surveyed the degree of use of the various course components and the students' attitudes toward them. These results indicate that students do make use of many of the alternative activities and that they do consider most of them to be worthwhile. The textbook remains the most frequently used course component, but the individualized problem sets rank a close second. All of the other activities were quite heavily used. In terms of usefulness, the students rated the lectures, problem sets, and practice sessions of highest value. The computer programs and textbook were also ranked high. Slide/tape programs, recitation sessions, sets of objectives, and the study guide were ranked lower but all were considered of some use in learning the course material.

We are planning to involve the computer more in this program, especially in diagnostic and management roles. Eventually we would like to have the computer assess each student's progress, to diagnose specific areas of difficulty, and to prescribe courses of action for remediation. This will require computer generation of questions, computer grading of answers, record keeping by the computer, and possibly the use of the computer to do actual testing and grading. We would continue to use our computer programs for instruction, but these would be just one component of the larger set of activities which could be prescribed for student use. The entire process would be managed and controlled by the computer with minimal instructor participation. The traditional course components would still be retained, however.

With the increased availability of hardware and software for computer utilization in science instruction, there is good reason for including the computer as part of our science teaching package. Our experience indicates that the computer has an important role to play, both now and in the future.

INCREASING SUCCESS IN AND UNDERTAKING OF SCIENCE AMONG URBAN MINORITY STUDENTS (PROJECT ISUS)

Carl Polowczyk, Bronx Community College

Project ISUS is an integrated program of televised instruction, computer-assisted instruction (CAI), computer testing, and computer management of a system approach to instruction. The project does not replace instruction but is an organized study and testing program that takes place outside the classroom.

The college has a Learning Center associated with its library, and a portion of it has been set aside for Project ISUS, where ten terminals and ten videocassette players have been joined into a computer-assisted televised system carrel.

The class still has two lecture hours or large group sections, one recitation hour or small group session, and three laboratory hours. Project ISUS impacts on all four components of the course; as viewed from the instructor's standpoint. These are as follows:

1. *A Study Guide Impact.* The study guide has clearly defined units. Each unit explains what is to be studied, why it is to be studied, a list of behavioral outcomes, and a set of learning activities that the staff has identified as being necessary to achieve the behavioral outcomes. There is no question of the details of the course.
2. *Lecture Impact.* The project has an impact on the lecture portion since students can obtain computer-assisted instruction on lecture content. The lecturer is aware of the emphasis present in the CAI and has confidence in the students' pace. He can spend time on those objectives that they recognize are difficult without feeling that every topic has to be covered in minute detail. Lecturers know that in many cases, A-V presentations will cover details.
3. *Recitation Impact.* The instructor knows that students have attempted a practice quiz prior to class, and come to class with content questions and homework problems. More intensive effort at problems giving students difficulties focuses instruction. Testing which normally took place in this session has been eliminated, giving more instructional time.
4. *Laboratory Impact.* The laboratory instructor knows that the student has viewed a TV tape, covering the details of the experiment, the calculations involved, use of standard forms, and instructions produced for the experiment by the Project.

From the students' perspective there are the following impacts:

1. The study guide clearly states what is to be done and why. The need for reading, homework, and class attendance is clearly stressed.
2. If the students follow this system, the lecture has more meaning, and the lecture content is reinforced by computer-assisted and A-V materials. A variety of instructional tools is used.
3. Students know where their problems are and can take advantage of the small group session to get more instruction in areas where they are weak and less instruction in areas they have mastered.
4. The preview of the laboratory TV tapes, including calculation, has shortened laboratory time and resulted in greater individualized instruction. Laboratory sessions become more problem oriented.
5. Testing is removed from a classroom setting. Students are tested when they want to be tested, after having completed all of the learning activities in the classroom, at the computer, on TV, and by other A-V methods. Students take a practice quiz on the computer. Unless they get better than seven out of ten, they cannot proceed to the real quiz. When

they have identified their problems and solved them, the real quiz is then taken under relaxed conditions with little test anxiety. They keep their test and know exactly where they are.

6. The Project has thus far resulted in lowering test anxiety and has produced a ten point increase in performance of a test group on a mid-term exam produced by non-project faculty, and on a final exam produced by a departmental committee.

The Project was managed in such a way that faculty writing CAI material and questions did not need to acquire any programming knowledge. One student put the computer-assisted instructional material into our PDP 11/40 using DECAL, an author language. One student put the practice quizzes into the machine using LAD, a system developed on campus. Two members of the faculty supervised the students and created the Student Management System which directs students' activities and records their responses. Faculty and student apprehensions about CAI have been minimized. The Project covers the first semester of general chemistry, a semester of qualitative analysis, and a semester of quantitative analysis. The Project Director invites requests to exchange TV tapes, computer tapes, and study guides.

COMPUTER-ASSISTED INSTRUCTION IN GENERAL CHEMISTRY

Alex Bonilla and Manuel Gomez-Rodriguez
University of Puerto Rico, Rio Piedras Campus

General Chemistry (Chem. 101) is taught at the University of Puerto Rico (Rio Piedras Campus) following two different types of educational formats. One is the Personalized System of Instruction (PSI) and the other is the standard lecture-discussion format. Computer-Assisted Instruction (CAI) materials were created specially for our PSI program covering all the fundamental topics of General Chemistry.

Computer programs (programmed in BASIC for Hewlett Packard 2000 Access System) were written for every PSI unit. The programs use Spanish as the communicating language, since most of our students are native Puerto Ricans and Spanish is their native language. An attempt was made to use CAI material from available sources. In doing so, we encountered difficulties such as no available CAI programs in Spanish, problems of integration of CAI into our PSI program, and a mismatch between available materials and our operational objectives. Thus, it became obvious that in order to be successful in our CAI project we had to develop our own materials.

We will outline the basic format followed in our CAI modules. For every operational objective that can be adapted to CAI, a typical exercise or problem is programmed. Usually we program a skeleton type problem where the computer randomly fills the blanks with data selected from a computer file. Students can answer problems with a numerical or alphabetical response. Problems can also be presented using multiple choice or true-false formats. Since the computer can actively interact with a user, the precise help can be given to the student at the right moment, creating a dialogue between student and "teacher." This enhances the learning process. Messages indicating ways to approach a problem, hints on how to analyze data, outlines of fundamental topics, and a step by step interactive solution to a problem are some of the ways our CAI programs help students when incorrect answers are given to the computer. As students cover all the operational objectives of a PSI unit using CAI, they can develop problem solving skills and at the same time master the chemical concepts under consideration.

Log-in is very simple and students identify themselves with the computer by their own student number. The machine will acknowledge the student with his or her name, and then the student selects the program or module to be performed. It is recommended that the student read the material from the textbook and from the study guide before working a CAI module. As the student works his way through a CAI program, information regarding performance is stored in a computer file. The professor in charge of the course can have access to this data that consists of the number of modules worked by the student, the number of exercises attempted in each module, performance on each exercise, time spent working on each module, total number of visits to the Computer Center, and course performance.

During the first semester of the 1978-79 Academic Year, the Chemistry Department enrolled 903 students in General Chemistry. Of that population, 457 students (50%) were enrolled in the CAI program and the rest of the students were utilized as a control group in the CAI module evaluation procedure. At the end of the semester the CAI students received a two-page questionnaire. In their opinion the CAI media were stimulating; they highly recommended the use of CAI to other students, and indicated CAI presentation was clear and of reasonable length and difficulty. A large number of students found that "learning can be fun." They found the computer to be "almost human" and highly interactive. By monitoring the number of visits to the computer center (6,211 for the entire semester, or 420/week) and the students' progress on a weekly basis, it was observed that the students were using the computer mainly as a study aid. About 80% of the students polled described the CAI modules to be imaginative, clear, and logical in presentation of solutions to problems. They found CAI material stimulated them to do extra work and keep up with the course.

Data obtained from student performance on CAI modules, Chemistry course grades, and College Entrance Examination scores were used in the evaluation of the CAI modules' effectiveness. The results were compared with the control group that did not use the CAI materials. Computer programs were written to make correlation tables between College Board Math scores with number of completed CAI modules, course grades with completed CAI modules, College Board scores with course grades, and correlation tables between grades with number of visits and time spent at the Computer Center.

The correlation between completed modules and course grades showed the following trend: low usage as measured by the number of completed modules tends to correlate with either a failure in the course or a deficient pass (a D grade). In order to complete a module, a student must achieve all the operational objectives that were programmed. The majority of students attempted all the modules, but in many cases they abandoned the module before completion. This was due to the fact that many students only completed those operational objectives within a module in which they felt deficient. For this reason, it was found that the number of attempted modules correlated poorly with success in the course. On the other hand, the number of completed modules, in excess of four, correlated well. Over this number of completed modules, reasonable grades (C or over) were obtained by the students. We found a large population of students with A's or B's that completed only one module. We considered the possibility of dealing with two different 'types' of student population. Two immediate possibilities came to mind. First, these students only completed the operational objectives in which they had difficulty, and second, those with sufficient skills and a good academic preparation found the additional computer aid unnecessary. To test these two possibilities, we prepared correlation tables comparing the number of visits versus course grades and College Board Scores.

An analysis of the correlation between the number of completed modules and College Board scores indicate the following trend: students that completed only one module are divided basically into two populations - one with College Board scores under 650 (on a local exam) and another over 720. Experience has shown that scores under 650 identify students with low probability of success in the natural sciences. These correlations provide additional support for the previous statement that students with a good background feel that they do not have to complete a given module, and work only those operational objectives in which they have difficulty. A correlation table between visits and course grades reveals a positive correlation between the two variables, thus explaining the number of low completed modules for some students with grades of A or B.

As a check of CAI effectiveness, we prepared correlation tables between College Board grades and General Chemistry course grades for the CAI users and the control group. In the control group we found that students with a low College Entrance Board tend to fail Freshmen Chemistry. Students with less than 600 in the Math section of College Board Exam correlated well with failure. On the other hand, the student population under 500 using CAI did very well. We found for this group that only 21% below 600 failed the course while the rest passed. It was observed that a C grade proved to be the most common grade for this population. This indicates that CAI is effective in helping students that are prone to fail the course.

General Chemistry unit exams and hour exams test students on abilities to solve problems, quantitative skills that go with the course, and processes of abstraction and application. Thus, the fact that CAI has assisted students to pass General Chemistry indicates its potential in removing some of the most basic educational deficiences that afflict our students.

SCIENTIFIC ACADEMIC COMPUTER PLANNING PROCESS

John Garner, Tougaloo College

Tougaloo College is purchasing an academic computer. Today, I plan to share with you some of what we have learned.

First, involve the faculty and administration in the planning process. We did this by inviting all possibly interested people to all the planning meetings and to use whomever came as the decision-making group. The more they are involved in the planning of the machine the more probable that the machine will be the correct one for you; that is, the one that the faculty and students will use most easily and widely. Openness includes the administration. It is important that they not think you are trying to mislead them. The more open you are with them the more open they will be with you and the quicker and easier will be the justification and ordering process.

Second, plan the computer usage. We did this by asking each academic department to list their wishes. In our case we discovered there were four basic areas: 1) Teach computer programming, 2) Solve problems in other classes, 3) Generate tests, and 4) CAI (Computer-Assisted Instruction).

Third, through the planning process learn from the experiences of others in similar situations, use consultants, and visit nearby computer installations.

A fourth planning consideration is the relationship between academic and administrative computing. An outside consultant may be of particular help here because he brings an off-campus objectivity. Consider your past experience. If joint academic-administrative use is planned, establish a procedure to resolve any anticipated conflicts prior to computer purchase and to resolve unanticipated future ones. There will be no conflicts if the machine is large enough, but that is frequently financially impractical.

Fifth, consider software. Design the system so that you have a mechanism for easily receiving software from other users. Avoid re-inventing the wheel, so to speak. Participate in the users group of the manufacturer of your company. Find out what other academic users are doing. It will give you ideas.

Sixth, consider your repair maintenance needs. The central components of the computer—the central processing unit, disks, tape, command console, and perhaps the printer—need prompt service, and plan for it. Input/Output (I/O) devices of which you have several, for example terminals, may not need as quick repair because losing one of them does not have a serious impact upon the computer's operation. Consider doing your own routine maintenance of terminals, returning them to the factory for repair, or having a spare parts kit. If you have an interested and qualified faculty member or two, they may want to build a terminal or two from kits which are available, in order to learn more about routine maintenance.

Seventh, on the basis of your expected uses, select the central components of the computer—the central processing unit and storage devices—disks and magnetic tape. Plan ahead so that the system will service expected needs for five years and it will be readily expandable beyond then. Plan so that when expansion is needed it will require the smallest possible additional money. Consider software availability, hardware flexibility, expandability, service available, and maintenance costs. Buy all the central components and the maintenance contract from a single vendor.

An eighth consideration is I/O devices. Again, select them based upon your anticipated needs. Magnetic tape is the most common way of transferring software from one user to another. It, combined with more-expensive but faster disks, is also needed for storing data and software. Cards should be considered. They are increasingly omitted in academic systems but if the expected users have data or software on cards, or are more comfortable using them than other I/O devices, one will want to consider if they should be included. Common academic I/O devices are terminals. There are some which print the results on paper and there are others which display the results on a TV screen. There are various levels of sophistication and one needs to ask what level is the most desirable. One of our consultants convinced me that the best is the simplest terminal which will serve the needs of the students. The simpler it is, the easier it is for the students to use it and overcome any fear of computers. At the same time it is very helpful to be able to expand the capabilities at a future date, for example, to convert a terminal to graphics as desired. Visit places where the type of terminal you are considering is being used in a fashion similar to what you expect. If possible, buy terminals on approval.

Ninth, the procurement procedure is important. Use a bidding process even if the proposal specified a particular manufacturer and model. Describe the needs in general terms in the bid request and send it to all possible interested parties. Place legal notices in newspapers. Advertise in computer magazines. You will get the best price and learn a lot about computers in the process.

Tenth, select the computer location carefully. For the central computer choose a place that is centrally located so that it is convenient to all users. Locate it where it will be available for student access as many hours per week as possible. Locate it where everyone feels that it is partly theirs and where no single group has an advantage over others. If some groups feel excluded, they will not use it as much and the students will suffer. For us, the best place was the library.

The location of the I/O devices is equally important. Printers, card readers, and terminals need to be easily accessible to the students so they usually should be placed outside the machine room where the central processing unit, disks, and tape drive are located. Plan to have them open to students as much as possible. This means avoiding locations that are frequently locked or are used primarily by one department or individual. You may want to locate terminals at several places throughout campus. That is good if it makes them more accessible to students and faculty. However, start with all the terminals in a central terminal room and gradually disperse them, based upon the use record. For example, if a department wants terminals moved nearer their offices or classroom, examine their terminal-use history for justification.

Eleventh, make timely final decisions neither too early nor too late. Consider all items carefully when you write the proposal. When the grant is received, review all the decisions in light of the experience you have gained since the proposal was written. When there is a good reason, make changes. Make decisions early enough to be sure beyond reasonable doubt to have the services available when they are needed. However, do not make them too early. The more you investigate and plan the more likely the decision will be the right one. It is best not to choose the whole system at once, particularly the terminals. Start with a few of several different types. See which ones are used the most. Buy more of that kind as you expand. You may want to take advantage of the shorter delivery time for terminals to decide the initial terminal purchase after you have decided about the central computer, thereby having time to get more information.

Twelfth, remember to train the staff. Without trained, excited faculty and computer center staff the best machine will sit idle, providing no benefit to the students. Remember to request adequate funds. Consider academic-year replacement time and summer training. Have a single individual with final authority over the computer. Provide him with enough time to assist faculty in course improvement. Do not waste his time with routine operation of the computer. Hire someone else to do that. Use student help when practical because they learn that way. When you agree to pay a faculty member to develop software, be clear what you expect to have accomplished and make its satisfactory completion a condition for payment.

Throughout it all, remember that the basic goal is to provide a better education for the students and to do so with the least amount of money. This is the overriding consideration.

INNOVATIVE INSTRUCTIONAL USES OF COMPUTERS AT JACKSON STATE UNIVERSITY

Jesse C. Lewis, Jackson State University

The uses of the word "innovative" in the title of this paper do not imply that Jackson State University devised or discovered some new way to use the computer in its instructional program. If the word is appropriate at all, it applies to the way we are using the computer or to the fact that for the first time the students at a minority institution in Mississippi had access to interactive computing.

It seems so right for the motivational effect and other advantages of the instructional uses of the computer to be applied where needed most. The culturally and economically advantaged students will be successful in college and life with or without access to computer-based instruction. However, this may not be true for students whose educational, economic, and cultural background is the product of a separate and unequal educational effort. There is a great need to motivate and provide individualized instruction for students who have not been exposed to many of the advantages of our society.

Support for an educational computing project directed at the culturally and economically disadvantaged student was sought by contacting and/or sending proposals to several corporations and foundations before COSIP-D/MISIP was announced. But for some reason, it seems that foundations, corporations, and federal agencies spend most of their funds to serve those whose need is least.

During the early 1970's an NSF COSIP-D grant was awarded to Jackson State University in which $30,000 was earmarked for computer terminals and the required data sets, cables, and communication devices. A short time later, six keyboard/printer terminals were connected to the University's IBM 360/40 computing system, and interactive computing was established at Jackson State. Eighteen months later, the IBM 360/40 was replaced with an IBM 370/145 and the number of terminals on campus increased from six to sixteen.

Why should a student be familiar with the use of a terminal or the potential of a computer? The answer is that today, we are in the midst of an information explosion. Our base of knowledge is doubling every ten years. We in education have to determine ways to accelerate the rate at which information is fed to our students. The computer is a large part of the solution.

The computer allows us to compress a vast amount of information and store it efficiently. Via a teletypewriter connection (i.e. the terminal), a student can quickly call up great storehouses of data and instruct the computer to carry out laborious calculations. Since less time is taken up in the execution of problems, the student has more time to analyze the results. The emphasis shifts from repetitious mathematical tasks to problem-solving and decision-making. The instructor has more time to stimulate the student's imagination, creativity, and critical thinking.

As the student interacts with the computer by means of the terminal, he becomes directly involved in the instruction process. He sets his own pace and has a tendency to work harder than if he were just reading a textbook. The immediate feedback from the terminal prolongs his concentration and motivates him to study still further.

Since calculation time is shortened, the instructor is able to use more realistic examples in his classes. In life, all answers do not come out even, as they have always seemed to on the answer page in the back of our textbooks.

So the interactive terminal provides two significant benefits. It increases the student's motivation and accelerates his learning rate.

To establish contact with the computer, a student picks up the telephone receiver on a terminal and dials a specific number. The computer responds with a request for an identification number and a password. As soon as the student enters those two items, the computer indicates GO. At this point, the student can use conversational and English-language-oriented commands to ask the computer for a "canned" program (a pre-written package), or if the student has some background in one of the computer languages (BASIC, PL/1, FORTRAN, or COBOL), he can enter a new program himself or re-write an old one.

All programs are controlled under MUSIC (McGill University System for Interactive Computing), a timesharing language, so that response time back to the terminal is never more than five seconds. MUSIC is easy to use, allowing students with little knowledge of computer operations or programming to use several applications.

In the beginning, the computer was primarily used for such mathematics-oriented subjects as business, computer science, economics, statistics, and mathematics. For example, let us assume that a teacher at Jackson State has reached the point in an elementary or remedial mathematics class where he wishes to intorduce logarithms. He gives the class the following definition: The logarithm of a number N to the base b is the exponent or the power to which b must be raised in order to obtain N.

Ninety percent of the class will admit that they don't understand (ninety-nine percent will not). The teacher may then ask the students to go to one of the computer terminals and find the following power of 10:

```
10**.3
10**.30
10**.301
10**.3010
10**.30103
```

They will get the following results:

```
10**.3     = 1.995262
10**.30    = 1.995262
10**.301   = 1.999862
10**.3010  = 1.999862
10**.30103 = 2
```

The teacher then says let us define .30103 as the logarithm of 2 to the base 10. Repeating the above general definition at this point could lead many of the students in the class to complete understanding. The students may then be encouraged to demonstrate for themselves (on the terminals) that logarithms can be used to multiply, divide, raise to a power, and extract roots.

Our efforts now include Computer-Assisted Instruction (CAI). For reasons which may be obvious, most of the current CAI efforts are in the English Department. The courseware being used was purchased from Notre Dame. The computer-assisted tutorials in English consist of 46 modules covering phonology, morphology, syntax, and mechanics. The lessons range from 8 to 25 questions each, and are independent of any particular textbook. The lessons are designed for sequential or random access. The programs are written in VS-BASIC. Courseware in History and Economics is also available, however, the major effort and emphasis remain in Mathematics and English.

INTERACTIVE COMPUTER-ASSISTED DRILLS AND EXERCISES IN SCIENCE COURSES AT HOSTOS COMMUNITY COLLEGE

Amador C. Muriel, Burlington County Community College

In 1976, Hostos Community College of the City University of New York, with the assistance of the NSF MISIP Program, started a small project on Computer-Assisted Instruction (CAI) in the sciences. In this report, I will describe its successes and failures, then submit recommendations which could make CAI useful to colleges which intend to use it.

The College is located in the South Bronx. Eighty percent of the students are Hispanic. Around 50% of the students are enrolled in remedial courses in mathematics or English, with English as a second language.

The hardware used was a PDP 11/40 running on a RSTS/E system. The core size was 96K, and a total of eight terminals were eventually available for development and student use. The minicomputer itself was inherited from a defunct administrative computer center. There was absolutely no educational computing available when the project started. Computer expertise was nil in the beginning.

Three faculty members in physics, chemistry, and biology were involved and the strategy developed was simple. Small programs, each 8K in size, were developed for topics of interest. Chaining of programs was used where necessary. Toward the end of the project, two years later, the involved faculty members were well-versed enough to use files, and therefore the battery of questions was expanded without the 8K limitation.

Our result is fairly simple. In an intense remediation setting, as well as in the proliferation of stretched-out courses, there was no success at all with highly interactive, individualized programs. Instead, students preferred a timed, drill-mode of instruction in all of the subjects tried (radiologic physics, astronomy, and chemistry).

Let me illustrate what we mean by highly interactive, individualized programs. One of our programs asked the student how many vectors he/she likes to add. The program then gives as many randomized vectors as he/she requested. The vectors are drawn on the terminal. The student then adds the vectors outside the terminal and keys in his/her answer. The program tells the student whether the answer is right or wrong, as well as provides the correct answer. The program could really be quite sophisticated.

I deliberately picked this example as a prototype of a program that demands good programming knowledge, but is nevertheless educationally faulty. In a remediation atmosphere, programs of this sort are wasteful. The student monopolizes the terminal, and if the programs are timed, the computer becomes an oppressive machine.

Contrast this rather sophisticated program with others that simply drill students in true or false, multiple-choice, or even spelling programs. The student gets instant response, and there is really no need to put time limits. The students set the time limitation themselves. The problem then becomes setting up question banks, which do not demand too much programming expertise. To repeat, I suggest here that in a remediation setting, it is much better to use CAI with drill modes, not with highly textual, or analytical instruction.

Let me now discuss other aspects of CAI as it relates to administrative, developmental, and implementation strategies. The use of computers is initially expensive. This objection, however, will be solved by forecasted decrease of hardware costs. Software development is expensive, on the other hand. Only big, privately operated, software developers could design courseware in a cost-effective way. If we assume that hardware costs go down, and courseware cost becomes manageable, CAI will still not find general acceptance until it is integrated into courses which reduce the cost of teaching. The only acceptable way of reducing the cost of teaching is not to cut faculty input, but to increase the cost-effectiveness of faculty. This means using faculty members as course managers of larger sections which are greatly helped by computers, such as the type discussed here. Unfortunately, in time of faculty negotiations, these matters are swept under the rug and most colleges will not be able to use CAI in an effective way for a long time to come. This is no longer a computing problem but a human management problem.

There are other problems we met in our project. Instead of discussing them individually, I would like to propose some do's and don'ts while you are planning similar projects.

Let's assume that you want to introduce CAI in your school. Here are some suggestions:

1. Get administrative support for peripherals and maintenance contracts.
2. Negotiate CAI into faculty contracts so that class size and contact time do not impede CAI implementation. This step could be avoided as long as external funding is available, but when soft money runs out, CAI should be made a part of an overall solution to reducing the teaching cost.
3. Hire experienced, and if necessary, expensive programmers. Faculty members should not keep re-inventing the wheel.
4. Document! Document!
5. Separate educational computing from administrative computing.
6. Identify computer enthusiasts and support them. Success will be imitated.

I hope that by using these pointers, most of you will be able to avoid our mistakes and errors in implementation.

IV. PANEL DISCUSSION ON TECHNICAL SYSTEMS FOR ACADEMIC COMPUTING

Technical Systems for Academic Computing.
Nellouise Watkins

TECHNICAL SYSTEMS FOR ACADEMIC COMPUTING

Nellouise Watkins, Bennett College

Educators have become acutely concerned with the drop in the level of scholastic achievement of entering college students. According to the report presented at the 1978 meeting of the National Association of Secondary School Principals, the national averages of the verbal and mathematics SAT declined noticeably since 1963. The verbal SAT decreased 49 points to 429. The mathematics SAT decreased 32 points to 470. These alarming statistics cut across boundaries of socio-economic background, race and sex. The general opinion is that colleges are faced with a generation of youth that has stared at a television screen since birth deriving questionable mental growth for the hours devoted. The thousands of hours that the child spent watching television during the important formative years of development have created a pattern of passiveness that is counteractive to motivation and the development of a thirst for knowledge.

The SAT statistics reflect significantly on minority institutions since the average SAT range for the students these institutions serve has been, and continues to be, lower than the national norm. We, as educators in these minority institutions, have neither the luxury of time nor finances to philosophize about the causes. Our task is clearly to take the students where we find them and move them forward as expeditiously as humanly possible.

The session you have attended for the past hour hopefully has stimulated your thinking about the impact the computer might make as one approach to the problem. Evidence indicates that Computer-Assisted Instruction (CAI) teaches . . . that students respond favorably to CAI, that there is a saving in time to learn, that the computer can be used to accomplish heretofore impossible versatility in branching and individualizing instruction, that natural and instructional dialogue is possible, and that the computer will virtually perform miracles in processing performance data.

Given that the computer can, in fact assist, where do we go from here? I would submit that the first decision should be, "Where, specifically, do you wish to go?" Once this decision is made by the institution, the type of computer to select, the personnel required, and the budget for computing should be put in one to one correspondence with the academic goals and objectives of the institution. Possible goals to be considered are:

1. Is your goal to train students for jobs in the computer industry?
2. Is your goal to prepare students to use the computer in their chosen profession?
3. Is your goal to use the computer to improve the quality and quantity of the students you graduate (i.e. competent in the basic skills)?
4. Is your goal a combination of the three former goals?

I repeat, the selection of the computer configuration, the required personnel, and the budgeted, computing dollars differ significantly depending upon which question describes your goal.

Before considering the differences based on goals, let us first look at the commonalities for successful academic computing:

1. Any computer selected should have a good track record of reliability, rapid and dependable service, predictable years before obsolescence and a price tag within your institution's budget.
2. The academic computing facility should have at least one or two advantages for administrative usage in order to raise its priority status in the college budget.
3. Computing dollars should be stretched by overall, long term planning with consideration given to all interested parties on campus, i.e. administration, faculty, students, and staff.
4. Computer technology represents a marked change in the educational process. College-wide preparation for and acceptance of the change should be sanctioned and promoted by top level administration.

5. The computer, when properly utilized, cuts across many facets of the college campus. A systems operator may have prime responsibility for its functioning but priority decisions, plans for faculty, staff, and student usage, and analyses of future projections are often best handled by a non-biased element, such as a computing committee.

Now let us take a look at the specifics of the goals.

Is the goal of your institution the training of students for jobs in the computing industry? At the undergraduate level, two major directions are generally considered: 1) training to program the computer and 2) training to maintain the computer. When the former is the direction, provision for a variety of languages, as Assembler, RPG, FORTRAN, COBOL, PL/1, and BASIC, enhance the student's chances in the job market. The emphasis should be provisions for batch processing on a main frame computer. The latter direction, training to maintain the computer, should be very effectively served by working with microprocessors. The assembling of the unit can help the student learn how the computer works.

Is the goal to prepare the students to use the computer in their chosen professions? In this direction, research and scientific applications are of prime interest. The student may be served by "smart" terminals or personal computers with floppy disks of pre-programmed statistical packages. In this category, also, teleprocessing to a nearby network via a cathode ray tube (CRT) or a hard copy terminal may be highly effective because of the availability of a large library of programs.

Is the goal to use the computer to improve the quality and quantity of the students you graduate? This goal is perhaps the one many of you give high priority. For clarification, we should delineate four terms used in the context of this goal:

1. Computer-Assisted Instuction. The systematic use of instuctional materials in regularly scheduled intervals for teaching, tutoring, drilling, testing and simulation.
2. Computer-Managed Instruction. The tracking of CAI to provide evaluation, prescription, motivation, and instantaneous feedback.
3. A CAI Program. Courses offered in a systematic, teacher directed, lecture/laboratory combined process where the teacher and technology share in enhancing the learning process and in evaluating results.
4. A CAI Resource. The elective use of courseware via terminals in the same manner as the library facility on the campus is utilized.

If the goals of the institution involve any of these categories, and if large numbers of students must be provided interactive computing capabilities over an extended period of time, the selection of a minicomputer with hardwired CRT or hard copy terminals would be the preferred configuration. Terminals with teleprocessing to a network would again be a satisfactory arrangement. The extensive library of network programs is highly effective when the goal is a CAI resource.

Once your goals and objectives are determined and you are going to make a decision, arrange for interviews with a number of computer sales representatives. The following checklist may be helpful in making the final decision on the best technology for your institution.

INTERVIEW CHECK LIST

1. *How does this unit compare in size to other units?*

   IBM 370 (large main frame computer)
   IBM 32 (medium computer)
   DEC PDP 11 series (minicomputers but wide range of sizes)
   HP 2000, 3000 series (minicomputers)
   Radio Shack Microprocessor (personal computer)

2. *How many students can be served adequately according to my institution's goals?*

   Terms: Main storage, (CPU), main memory, 30-50k (For academic computing usually under 1,000 students), 35-125k (For academic and limited administrative computing—usually 1,000-5,000 students), 128-256k (For academic and administrative computing—network size)

3. *How much additional memory is possible?*

   Terms: Disks, Megabytes, Floppy Disks
   Number of megabytes per disk.
   Total number of disks that can be supported.
   Floppy disk capacity.

4. *What kind of terminal support?*

   Terms: Cathode Ray Tube (CRT), Teletype (TTY), hard copy, graphic
   Number of terminals supported in base configuration.
   Support of terminals of a different brand.
   Turn-around time.
   Batch processing at the same time.

5. *What languages are supported?*

   Terms: BASIC, FORTRAN, COBOL, RPG, APL, PASCAL, ALGOL
   Which are simulated?
   Which came with system?
   Additional languages purchasable or leased?

6. *Administrative software operable and/or supported?*

   Terms: Accounting, Billing, Scheduling, Grades, Batch Files, Management, On-Line Registration
   With system?
   For purchase? For lease?
   Documentation?
   User-contacts?

7. *How many programs are available in library?*

   Magnitude? Variety?
   Supported? Documented?
   Available with system? Lease? Purchase?

8. *Does the system have "author" capability and capacity?*

   How much programming knowledge is required?
   How much JCL?
   Simplicity of process?
   Transportable?

9. *What other units can be supported?*

   Printer (100±1/m)?
   Mag tape?
   Card reader/punch?
   Paper tape?
   Plotter?

10. *What is the projected obsolescence date?*
    When was first system issued?
    What is the newest system on the market.. what's the difference?
    Is it possible to upgrade the system?

We have referred briefly to main frame computers, minicomputers, personal computers or microprocessors, "smart" terminals, and teleprocessing to network. Panel members will enhance your knowledge further along these lines.

V. REINFORCEMENT OF ACADEMIC SKILLS

The Development of an Academic Support Facility for the Sciences.
Richard G. Ross, Ernest J. Baca and Robert I. Lonard

The Guided Initiative Academic Advancement Reinforcement Systems Approach -
A Viable Alternative to Traditional Science Education.
J. Henry Sayles

Development of Basics in Mathematics and the Sciences:
"Lecture-Laboratory Format".
Darius Movasseghi and Mahendra Kawatra

Student Motivation and Achievement at Our Lady of the Lake University.
Michael E. Campbell

Reinforcement of Basic Skills in Chemistry I Course.
Mary Abkemeier

Reinforcement of Computational Skills at Norfolk State College.
Phillip McNeil

Eliminating "Mathematical Illiteracy" at the Freshman Level:
A Modularized Mathematics Program.
Argelia Velez-Rodriguez

Development of Supportive Materials in Mathematics and Science
in a Lecture-Laboratory Format.
Mahendra Kawatra and Darius Movasseghi

THE DEVELOPMENT OF AN ACADEMIC SUPPORT FACILITY FOR THE SCIENCES

Richard G. Ross, Ernest J. Baca and Robert I. Lonard
Pan American University

Although the MISIP Program at Pan American University involved several components, the Biology Department projects and their evolution provided the basis of this investigation. Audio-tutorial courses in Environmental Biology and Plant Taxonomy were each offered twice during the 1977-78 academic year. These courses were completely individualized with students receiving their instructions through slide-tape programs at study carrels equipped with Caramate players. Study guides with specific instructional objectives and sample test items were prepared to accompany each program. Approximately 130 students enrolled in these courses and formally and informally evaluated the method utilized. Based on an extensive analysis of student reaction, the audio-tutorial method was discontinued as the primary teaching technique. Students expressed a need for more group instruction and interaction with the instructor.

The materials developed have recently been used to supplement traditional group instruction. In addition to the students in the courses mentioned above, these materials have been adapted and supplemented for use in the General Biology course which serves approximately 800 students. To accomodate such large student numbers, a Science Learning Center was established in the centrally-located Learning Resource Center. The Center, staffed by teacher-tutors, can accomodate 50 students at any time.

This study was designed to determine the effectiveness of the supplemental materials in enhancing the success of students in a General Biology class. The class was dichotomized into two groups. One group, designated high-use, utilized the materials a minimum of five hours per semester. The other group, designated low-use, spent from 0-5 hours utilizing the individualized materials. Members of the high-use group were matched with members of the low-use group on the basis of their ACT Natural Science scores. From these matched pairs, 30 were randomly selected for this investigation.

The following null hypothesis was tested at the 0.05 level of confidence: There is no significant difference in the mean final score between the high-use and low-use groups.

Subjects for both groups were selected from those students enrolled in the first semester biology course at Pan American University. This course (Biology 1401) serves as an introduction for both Biology majors and non-majors. *Biological Science* by William T. Keeton is the assigned text and *Laboratory Experiences* by Ross and Ross serves as the laboratory manual. Twelve slide-tape programs and a *Study Guide for General Biology* by Lonard and Ross were provided as supplemental materials in the Science Learning Center. The section of the course was taught by one of the investigators and was selected because of its high enrollment (118).

Pan American University, located in Edinburg, Texas, has an enrollment of approximately 8,500 students of whom 80% are of Mexican-American descent. Over 90% are commuting students living at home in some of the communities of the Lower Rio Grande Valley of Texas. The majority of the students are employed either on a full-time or part-time basis.

The following steps were followed in the development and completion of the study:

1. ACT Natural Science Scores were obtained for all students enrolled in the class.
2. The time spent using the slide-tape programs was recorded by Science Learning Center staff.
3. All students who spent over five hours using the programs were selected as the high-use group.

4. Based on ACT Natural Science scores, each member of the high-use group was matched with a student who spent less than 5 hours using the materials.
5. From these pairs, 30 were randomly selected to serve as comparison groups.
6. Final numerical grades were obtained for all group members.
7. Data were analyed using "Students' t" to determine if a significant difference in the mean final grade existed between the groups.

Of the 118 students enrolled in the course, 104 completed all requirements. A total of 41 students utilized the supplemental materials over five hours during the fall semester of 1978. The 30 selected for this study spent an average of 9.7 hours using the materials. The 30 matched low-use students spent an average of 0.7 hours with the supplemental materials. The mean final grade for the high-use group was 76.9, while the mean final score of the low-use group was 69.8.

The null hypothesis stating no difference in mean final exams scores was rejected on the basis of the calculated t value (t=2.4 significant at the 0.05 level). Those students making high use of the slide-tape materials performed significantly better than those who made little or no use of these supplemental materials.

The results of this study indicate that students using the provided materials are more successful than those who do not. Although the groups were equivalent, based on knowledge of natural science, there could be other differences between the groups which could partially account for these results. The degree of motivation as expressed by their willingness to take advantage of the facilities may indicate that these students are more strongly motivated and are spending more time studying for the course. The students from the low-use group, however, did make use of other academic assistance on campus to the same degree as the high-use group so this difference can be largely discounted.

Based on this study, the following two recommendations are made:

(1) Additional investigations with more controls should be made with additional courses and larger numbers of students, and

(2) Slide-tape programs should be developed in other science disciplines.

Further studies are underway, and Chemistry and Physics programs are either completed or in progress.

THE GUIDED INITIATIVE ACADEMIC ADVANCEMENT REINFORCEMENT SYSTEMS APPROACH - A VIABLE ALTERNATIVE TO TRADITIONAL SCIENCE EDUCATION

J. Henry Sayles, Bennett College

Bennett College has initiated an innovative experimental program in teaching technology to permit students the opportunity to integrate theory and practice in mathematics and in the biological and physical sciences in a professional setting based on a need of hierarchy assessment. The primary goal of this program is to promote the intellectual and emotional development of students by exposing them to an entirely new environment which differs from that usually associated with the traditional means of taking courses at the undergraduate level. In reality, the students now have a viable alternative to the traditional way of taking courses. This experimental program is entitled the "Guided-Initiative Systems Design Approach." The Academic Reinforcement Center at the college, made possible by a MISIP grant, is being used to implement this program. This Guided-Initiative Systems Design Approach focuses on open-ended problems and on establishing a need for the materials the student is expected to learn. It requires the student to take the initiative in learning, using the library resources (textbooks, monographs, reference books and scientific journals) as well as laboratory experimentation.

The objectives of this project component are:

1. to promote the intellectual development of students by exposing them to an environment which differs from that usually associated with the traditional means of taking science and mathematics courses at the undergraduate level, and
2. to reinforce the classroom coverage of those scientific principles which students often find difficult understanding with supplementary illustrations, applications, examples of problem-solving techniques, and to expose the students to instructional materials more advanced than that covered in the regular classes.

The philosophy of the Academic Reinforcement Program at Bennett College is to provide academic experiences designed to accelerate the scholarly development of students who enter college with unrealized scholarship potential in science and mathematics. The emphasis is on open-ended problems and on establishing a need for the materials the student is expected to learn. A variety of audio-tutorial devices are used. The course modules are developed by the professors for the students enrolled in the various science and mathematics courses.

In using these automatic tutors, students are able to assimilate concepts and problems at their own pace until a clear understanding of each unit is achieved. The student reads, observes, writes, and listens.

The course modules are open-ended. Each module presents materials more advanced than possible to be explored in a traditional classroom setting and each module is designed to create the need for more knowledge about various scientific principles and problem-solving techniques.

The student population being served consists primarily of black women majoring in biology, chemistry, mathematics, and engineering (dual degree), and young men enrolled at four nearby institutions, but taking courses in science and mathematics at Bennett College in a cross-campus, cooperative program.

Based on the results to date, there is no escape from concluding that the Guided-Initiative Systems Approach has resulted in a significant increase in the percentage of students earning above average grades in comparison with the 1975-76 control group. Only students earning grades of "C" or above are included in this evaluation.

DEVELOPMENT OF BASICS IN MATHEMATICS AND THE SCIENCES: "LECTURE-LABORATORY FORMAT"

Darius Movasseghi and Mahendra Kawatra
Medgar Evers College

In pursuit and promise of college level study for everyone who desires it, many institutions across the nation, especially the City University of New York, have opened their doors more and more to the high school graduate population. This era of so called "open admissions" has been quite rewarding for educators, faculty and especially students, and at the same time has made educators and faculty look a little deeper into ways of modifying the method of instruction. In addition, during this period there has been a rapid decline of the competencies of entering college students in basic skills, particularly in mathematics and natural sciences, nationwide and especially from an urban setting. Recognizing the vital importance of the mastery of these skills for the eventual success of the students in any academic curriculum of higher education, it is essential for all institutions to address themselves to this problem. Therefore, it is quite apparent that the goal of providing education for all must be modified in some ways in order to give attention to providing education for each. Such modification is infinitely more complex and demanding than the initial goal. In this endeavor, almost all institutions have developed appropriate courses, and have attempted to improve upon both the content and instruction of these courses. In addition, it has been recognized that the eventual success of students in these courses, in general, is not possible without an appropriate supportive system as an adjunct to regular classroom instruction.

We, having examined various modes of instruction, have come to the conclusion that unless the supportive system in these courses is an integral part of the total instructional process, an effective use of the materials and facilities will not be achieved. Therefore, we have adopted a well defined method of instruction in which the mode can best be described as Semi-Individualized Professionally-Determined Pace (SIPP). The basic features of this mode of instruction is the integration of lectures with activities in the laboratory creating a lecture-workshop situation. The instructional process in this format includes the modularization for the course content, which is self-pacing with a well defined time frame for achieving the objectives for each module. The instructional process takes place in a large room (center) divided into two parts clearly identifying a lecture area and the laboratory. The lecture area has a seating capacity for about 25 students and the laboratory is equipped with ten study carrels each of which is furnished with a videotape player and a color monitor. In addition there are several audio tape recorders available for use.

The classes taught by the SIPP mode of instruction meet in the center three times a week. The first meeting of each week is a formal lecture where the instructor covers, for most part, all the material assigned for that week. During this period the presentation is centered around the development of concepts and the major skills needed for the algorithm. The other periods are designated as workshop sessions during which time students work individually or in groups using one of the following aids:

1. Videotape equipment with appropiate materials
2. Audio tape cassettes with appropriate materials
3. Reading materials

The main objectives of these workshop sessions are to ensure that the students have mastered the basic concepts and that they can utilize the skills necessary in problem solving. The major task of the instructor (with assistance from the laboratory coordinator and tutors) is to assist students in overcoming the difficulties whether in topics already covered or in new topics. Students are expected to finish a module generally in two weeks (the material covered in a semester is divided into modules and the time span chosen accordingly) and a unit examination is given at the end of this period. However, the students are allowed, and encouraged, to take this examination as soon as they are prepared. A student who passes a unit test with a predetermined score (generally about 80%, or higher) prior to the end of the module-period, moves on the the next module. During the module-period, the students are allowed to take such a test, at most, three times and the highest score is recorded as the student's performance level for that module. A comprehensive examination is given at the end to ensure proper retention of the course material. This encourages the student to have a broad understanding of the subject matter.

In summary, SIPP, a very active interaction between the instructor, the laboratory coordinator, and tutors on the one hand, and a student on the other, in a well organized educational setting, provides a natural motivation on the part of the student. The cognitive learning is provided for the students through the lecture, while in the workshop setting the use of ancillary materials with clearly specified behavioral objectives enables a student to attain the goal of the course successfully. Finally, multiple opportunity in uplifting one's scores in each test within a well-determined period of time and having to utilize the A-V materials individually, without any external prodding, enhances the student's intrinsic motivation and helps him to participate meaningfully in other learning situations.

It is noteworthy to point out that this mode of instruction was used at our college for the teaching of the basic mathematics course for a year and the analysis of the results with respect to both student attitude toward the mode and to his achievement was very encouraging. For example, the mean difference between the post test and a pretest scores was 10.0 with a standard deviation of ±5.3 for the group using the SIPP mode while the corresponding numbers were ±8.1 and ±5.4 respectively for the group using a standard lecture with unlimited tutoring.

STUDENT MOTIVATION AND ACHIEVEMENT AT OUR LADY OF THE LAKE UNIVERSITY

Michael E. Campbell, Our Lady of the Lake University

It is almost axiomatic to say that the motivated student is a professor's dream. Such a student is like a loaded weapon in the hands of a marksman, simply waiting to be aimed and fired at the target. This analogy is apt, to be sure, for virtually all students. Problems arise when after strenuous years in graduate school, the marksman (or professor) expects the sights to be perfectly aligned and the student to hit the mark with the first shot. It is the rare student, capable of such a feat, that we readily term "motivated". However, I submit that all students are motivated to achieve from the instant we find them in our hands. Motivation is one of the biological and psychological "givens" of existence. Certainly the caliber of some students is not appropriate for some targets, nevertheless, they *are* motivated and it is our job as educators to assure that the sights on the weapons that we certify as baccalaureate material have been adjusted before they are sent out on the big hunt—job hunt, that is.

The majority of students at Our Lady of the Lake University are Mexican-Americans from the Barrio section of town. One of the first things you notice about many of them is the slight accent in speech. A closer listen reveals grammatical improprieties such as a misused pronoun or verb tense and uncertainty about the meanings of some words. As children, many grew up hearing only Spanish at home but when they went to school they were compelled to use English. They have lived their lives according to one set of rules, learning what was expected and how to respond to get reinforcement, and then suddenly, without warning, the rules were changed. What was worse, many of their classmates and almost all of their teachers had never lived under any other rules and were miles ahead of them in use of the English language. This is undoubtedly a frustrating experience of major proportions. Humans have a set of fairly typical reactions to frustration. Since nobody wants to be wrong and feel badly about himself, one of the first things they do is try to correct whatever is wrong so that they can continue receiving rewards as before. The bright ones and those with some previous experience with English and Anglo social mores succeed. The ones that fail begin to learn that they cannot control things at school. They begin to believe that they cannot succeed because school operates under some mysterious principles that only teachers, Anglo children and a very few, very bright Chicanos can understand. This lesson is learned well over the next twelve years of public education.

Let us examine the elements of this feeling of academic helplessness. It began in childhood with the unpredictable intrusion of a foreign institution into the life of the student. This intrusion is a significant thread in the fabric of the student's life because the degree of his success in the predominant social structure is highly correlated with his success in school and even more so with his ability to use the English language appropriately. Our students also learned that they had little control over the rewards available through the system. These three things, unpredictability, life significance and uncontrollability are the elements of what Dr. Martin Seligman of the University of Pennsylvania has termed "learned helplessness". Helplessness causes the subject to appear apathetic, disinterested, and depressed. The helpless individual does not even attempt to control the events in question because he has learned to expect failure. This is the kind of student we are used to calling unmotivated.

I suggest that helpless students are not necessarily unmotivated. Their sights are just badly aligned so that upon aiming, they consistently miss the target. To this point, the problem now is how to realign the sights to produce a more efficient tool.

The chief sympton of helplessness is inactivity. The victim doesn't try because he *knows* he cannot succeed, or if he does try, the effort is merely token. The situation is like the married couple bent on divorce who enter marriage counseling "just so they can say they tried everything." The problem then is failure in academic skills, the chief symptom being inactivity. The remedy is to devise methods to force the student to be active, and to force the student to control the academic contingencies with which he is faced.

In very practical terms this involves a number of direct steps. First of all, the concerned educator must maintain high academic standards. Grade inflation is a problem throughout education in this country. The minority college student who has consistently experienced failure in public school then suddenly, unpredictably and uncontrollably finds himself succeeding in college through the good graces of instructors who are sympathetic with his background is more convinced than ever of the enigma of education.

Finally, an educator can do one thing that almost obviates the previous two considerations. That is to find ways to include the student as an active participant in the learning process. Almost anything a professor can do to increase the physical activity of students in his or her classes will increase the control the individual student has over a given subject matter. Although homework assignments are virtually outmoded in universities and colleges across the country, they require extensive intellectual participation by students and provide excellent feedback for the professor regarding student progress and understanding. For two successive years I have alternated semesters in Introductory Psychology requiring either weekly quizzes and term paper in addition to midterm and final exams or requiring only the midterm and final exams. During the semesters requiring more activity, I had a greater percentage of B's and C's on the final exam and fewer F's than during the less demanding semesters. Lectures and final exam questions were the same in both cases. More activity resulted in higher grades and fewer failures.

If a weapon shoots left, it is a waste of time to aim right. The marksman must adjust the sights or the weapon will continue to be inaccurate. Likewise, active adjustments are requisite for producing quality students. These adjustments require more effort from the faculty; a discussion or lecture is easier than grading a homework assignment or written exercise. But, you get what you pay for, and the reduced effort causes a loss in student learning.

REINFORCEMENT OF BASIC SKILLS IN CHEMISTRY I COURSE

Mary Lee Abkemeier, LaGuardia Community College

LaGuardia Community College is a unit of the City University of New York and as such accepts students under an "open admissions" policy. A high school diploma or an equivalency is the only requirement for admission. Many students entering college under an "open admissions" policy are under-prepared in basic skills. Entry level programs for upgrading basic skills are frequently only partially successful in that students do not learn how to apply the skills in all content areas, or that students do not necessarily transfer the skills to study in a content area, even when application has been learned.

Examining a course and building into it a basic skills reinforcement substructure is a difficult task. While educators around the country say it should be done, to our knowledge no one has done it. In an effort to address the vital basic skills issue, the Integrated Skills Reinforcement (ISR) project has been initiated at LaGuardia Community College. The project is being carried out in three phases. Initially, a task force of faculty specialists in the basic skills areas of reading, writing and speech analyzed and outlined the step-wise development of these skills. The team also noted the expected skill levels of students upon exiting from each course in the remediation program at LaGuardia.

During the Fall (1978) quarter, selected faculty from each department in the school worked with a member of the basic skills team to analyze a course each would be teaching in the winter quarter to determine instructional areas in which reinforcement of the skills could take place in a structured manner without detracting from the course content.

In the present winter quarter the individual skills reinforcement "packages" are being used and evaluated.

The specific strategies upon which faculty focused in the preparatory quarter were grouped as follows:

1. Identifying students' reading, writing, speaking, and listening competencies,
2. Preparing students to read difficult material,
3. Helping students write successfully for specific course goals,
4. Helping students develop a formal oral presentation to meet specific course goals,
5. Helping students clarify what they have learned from readings, writing assignments, and lectures through developing critical discussion skills.

The first group of strategies, as applied to the Fundamentals of Chemistry I course indicated that many students, though having completed necessary remedial reading courses, may not be reading at the college level, the level at which the textbook is written. The exit criteria for the reading program are slightly below college level. A questionnaire was prepared in order to determine what basic skills courses each student had completed as well as to give an indication of the student's writing abilities so that the instructor might set realistic expectations of student performance.

As a preparation for using the textbook efficiently, a preview exercise was designed to acquaint the student with the important features of the book. These included such items as the location of sample problems and problems distributed throughout the chapters typically assigned for student work, distinction between figures and tables, location of the glossary, the appendices, and a section of color plates in the text.

The performance objectives, which have long been a part of the course, were introduced as guide questions to aid in reading the textbook material. Additionally, cue words (i.e. identify, explain, distinguish between, determine) used in the objectives were explained to the class with appropriate examples of each in order to clarify precisely what kind of information or performance is sought with each objective.

Laboratory reports were chosen as the vehicle through which writing skills could be reinforced. While an appropriate format, presentation of data, calculations, and interpretation of results had always been stressed, minimal emphasis had been placed on the manner in which the discussion and/or evaluation of the experiment had been expressed. Thus the discussion section of laboratory reports was singled out as the area for emphasis on writing. A logical way to organize the discussion together with a list of writing errors that would be noted on reports was prepared as an aid to the students. Since oral presentations are not required in the course syllabus, the corresponding set of strategies was not utilized.

The last set of strategies was embodied in brainstorming techniques and specific lines of questioning which were used in the classroom to lead students to organize their thinking processes as well as the information and techniques presented in the class. These techniques were further utilized in the preparation of minicourses and audiotapes placed in the science learning center to supplement classroom instruction.

At the writing of this paper, the effectiveness of the ISR materials remains to be seen. There has, however, already been a marked improvement in the quality of the discussion section of laboratory reports. This is attributable to the clarification of the specific writing assignment as well as the grammatical criteria by which it is judged. It is hoped that the additional awareness of the instructor of the actual skill levels of the students in the course, combined with the effort to tailor instructional materials to the appropriate student level without allowing content of the course to suffer, will decrease attrition from the course and enable students to experience the success that will motivate them to continue in science or science-related careers.

REINFORCEMENT OF COMPUTATIONAL SKILLS AT NORFOLK STATE COLLEGE

Phillip McNeil, Norfolk State College

The Mathematics Department of Norfolk State College is conducting a program of computational skills improvement begun in 1974 under the college's MISIP grant. The objectives of the program are:

1. to help bridge the gaps in basic mathematical skills which accompany so many of the college's entering freshmen, and
2. to enhance the college's efforts to provide students with needed literacy and expertise in computer science.

The Progran serves the majority of the college's 1500 entering freshmen. It features a learning resources center for basic mathematics skills, and a computational center for basic computer science skills.

1. Basic Mathematics Skills

The mathematics skills portion of the program is centered around the Mathematics Reinforcement Center, a two-room laboratory containing study carrels, sound-slide equipment, a small paperback library, and a testing station. The Center is manned by student tutors and laboratory assistants, and its overall operation is directed by a member of the mathematics faculty.

Students who enroll in the general education mathematics course, Math 101, are required to demonstrate a prescribed proficiency on selected, basic mathematics skills ranging from simple arithmetic to elementary algebra. The skills are subdivided into 16 learning packages out of which each student is expected to test as one of the requirements for passing the course. Each package is comprised of a pre-test, a body of skill-related material, and a sample post-test. (The design for the learning packages was developed by faculty members during summer workshops provided for under the MISIP grant.)

After the students' skill deficiencies are determined by means of an initial diagnostic test, the students are expected to use the facilities in the Reinforcement Center to aid them in completing the packages which cover the skills in which they were shown to be deficient. The learning package component of the Math 101 course is self-paced in the sense that students take and retake package post-tests whenever they feel prepared.

The Mathematics Department is monitoring and evaluating the results of the learning package program in two areas: (1) pre-test, post-test improvement, and (2) collective failure rate for the Math 101 course. Data collected thus far indicate that entering freshmen who enroll in Math 101 demonstrate proficiency, on the average, in only two to three of the 16 packages at the beginning of the semester, which represents the successful completion of an average of 15% of the diagnostic test items. At semester's end and after exposure to the package program, these same students score an average of 65% on those portions of their common final examination that relate to the package skills. Since very little classroom time is devoted to package skills, the improvement in test scores must be largely attributable to the package program in the Mathematics Reinforcement Center.

A second evaluative index for the package program is the rate of failure in Math 101. During the five years prior to the advent of the MISIP Program, a stable average of 25% of the first semester students enrolled in the course received failing grades. The failure rate dropped dramatically to 13% in the semester in which the package program became operational, and it has not risen above 17% in any subsequent semester. The five-year average failure rate beginning with the MISIP years is approximately 14.5%.

Aware of the pitfalls inherent in drawing valid inferences from such data, especially the difficulty in isolating the variables responsible for the data, the Mathematics Department is assuming a cautious, but optimistic, attitude about the program. However, the MISIP-based program has identified the two target areas described above, and a vehicle - the learning package program in the Reinforcement Center - by which progress in mathematical skill building at the college can be concretely measured.

2. Computer Science Skills

Prior to the receipt of the MISIP Grant, opportunities for students in the computer science area at Norfolk State were slim. The Mathematics Department offered three basic courses in computer science: one literacy course for non-science majors and two elementary programming courses for Science Division students. These were supplemented by a sprinkling of elementary courses in other divisions of the college. The opportunity for students to acquire hands-on experiences with computer equipment was severely restricted, since the college's IBM 1130 Computer System was used almost exculsively for the business and the administration of the college.

With MISIP funds, the department was able to: (1) provide advanced training in computer science for two of its members, (2) provide release time for faculty to plan and design new computer science courses and programs, (3) purchase a small self-contained minicomputer system, and (4) set up a computational center which houses the minicomputer system, and which is used exclusively for computer science instruction.

The results for these efforts over a three-year period are: (1) enrollment in the computer literacy course has quadrupled; computer science enrollment generally within the department has almost tripled, (2) the computational center serves approximately 150 students per day, who are writing programs, or running programs on the computer system, or researching computer science topics in the small library contained in the center, (3) the department's computer science offerings have increased to 24 hours of courses which cover the major programming languages, topics in machine language, hardware and software systems, computer organization and design, and data-based management systems, (4) the Science Division has noted a substantial increase in the usage of the computer in its upper level science and mathematics courses, (5) the department has created a new degree program–B.S. in Mathematics, Computer Science Emphasis, with a planned expansion to a B.S. in Computer Science.

The successes outlined in this paper are clearly preliminary. They are, nevertheless, substantial enough that the Department is committed to greater improvement in the mathematics skills area, and continued expansion in the computer skills area. Since the termination of the MISIP grant in 1976, the skills programs have suffered shortages of space, equipment, and personnel, but the programs continue largely through the voluntary efforts of a few dedicated faculty and a sympathetic administration. These difficulties notwithstanding, the MISIP-based skills program at Norfolk State College in broad terms provides a good argument that a mass approach to computational skill enhancement is feasible at a large minority institution.

ELIMINATING "MATHEMATICAL ILLITERACY" AT THE FRESHMAN LEVEL: A MODULARIZED MATHEMATICS PROGRAM

Argelia Velez-Rodriguez, Bishop College

The Bishop College's Modularized Mathematics Program (MMP) is one of the major components of the NSF-MISIP Project. The two principal concerns that led the members of the Mathematical Sciences Department to begin their search for alternatives to the traditional method of teaching freshman mathematics were: (1) the linguistic and computational deficiencies of the majority of Bishop College's entering students, and (2) the increasing number of potential students who wished to pursue careers in science, mathematics and technology and who were inadequately prepared to enter into the respective programs.

As a math instructor at Bishop College for more than ten years, the author was convinced that the traditional classroom-lecture method would never improve the students' mathematical, computational and problem-solving skills. Having been involved with individualized instruction, self-paced learning approaches, and programmed learning approaches to remediation as Director and Coordinator of NSF In-Service Programs for Secondary Mathematics Teachers in the Dallas area, the author strongly felt similar learning modes would work at Bishop College.

Careful consideration was given to every facet of the college's program, and after long hours of critical and comprehensive study, a modularized mathematics program was proposed as a major component of the MISIP project. The objectives were as follows:

1. The development of mathematical concepts,
2. The reinforcement of mathematical and problem-solving skills,
3. The assistance of less-capable students by making available concrete and manipulative materials and devices to improve motivation,
4. The improvement of the students' ability to formulate problems and apply quantitative methods,
5. The provision of more opportunities and incentives for independent study, and
6. The improving of the student's self-confidence, and the increasing of his/her chances of success by exposing him/her to the usage of electronic devices commonly used in graduate school and the work world.

In order to accomplish these objectives, it was stated that at least three components would be necessary. They included: (1) a faculty training program, (2) a period of two semesters of field testing and revision of the materials developed by the faculty, and (3) the total implementation and evaluation of the program.

The in-service training consisted of a four-week summer workshop designed for the mathematics staff. The following topics were included:

1. Philosophy of Modularized Course Structure,
2. Learning to Formulate and Write Instructional Objectives,
3. Identifying Skills and Concepts,
4. Developing Materials (Enabling Activities),
5. Developing Pre- and Post-tests, and
6. Revising Diagnostic Instrument (Placement).

The workshop was conducted by John L. Creswell, Professor of Curriculum and Instruction, (Mathematics Education), College of Education, University of Houston, Houston, Texas, assisted by the author.

The Fall Semester, 1976, was a trial run of all modules developed during the summer. The initial implementation of the program was restricted due to inadequate physical facilities and limited instructional media. In spite of the difficulties encountered, an assessment of the effectiveness of the self-paced learning in Math 1300 (Basic Math) was conducted. Pre- and post-tests of achievement and attitude were administered to all students who enrolled in the course. The pre-tests were administered early in September (about two weeks after classes began) and post-tests were administered in the first week of December. During that semester, 215 students were enrolled in Math 1300; 75% took the Pre-Attitude Survey and 71% took the Pre-Achievement Test. At the end of the semester, 62% took the Post-Attitude Survey and 53% took the Post-Achievement Test. There were no control or experimental groups for comparison. The only comparison possible was made in the overall changes of the population who took all four assessment instruments (52% of the original population).

The MMP consists of three courses—Math 1300, Math 1311, and Math 1312. All instruction is programmed and self-paced. The first course, Math 1300, consists of 33 modules (7 units). It reviews and reinforces basic arithmetic principles and computations. The second course, Math 1311 (Quatitative and Analytical Thinking I), consists of eight units and a total of 17 modules. It includes denominate numbers, metric system, elementary algebra, logic and introduction to computer programming (BASIC). The third course Math 1312 (Quantitative and Analytical Thinking II), consists of six units comprised of 20 modules. It covers topics in intermediate algebra. Each of the three courses carries three credit hours. Credits for Math 1300 are not transferable and do not count towards the institutional mathematics requirements.

Programmed materials, tapes, workbooks, and drill exercises developed by the staff provide alternatives to the basic textbooks. The MMP is offered exclusively in the Mathematical Sciences Learning Laboratory. It occupies a large area which conveys a sense of openness and freedom. The program could be called informal in the sense that no lecture exists, but it is structured in such a way that it demands much of its students, forces them to develop self-discipline and organize study skills, and more importantly, it makes them realize that the responsibility of learning relies on the learner.

Students spend five hours per week in the Learning Laboratory. Each student, with a textbook and modular outline, studies the content and independently tackles each assignment, seeking help from the instructor whenever needed. There are two instructors on duty at every scheduled class, and generally a peer tutor is also available. The tutor does not necessarily need to be a mathematics major, but can be any sophomore, junior, or senior who possesses a strong interest and ability in the subject and is a sensitive, reliable person.

When a student believes that the material in a particular module or unit has been mastered, he/she goes to the testing area and takes the appropriate test. The tests are graded by the instructor or a student tutor and are returned the next day. A student who failed a test may take another test that is different but theoretically equal in content and difficulty. There is no limit to the number of tests taken on a given module or unit. However, a passing grade must be attained before the student is credited with completion of that unit. The course grade depends primarily on the number of units completed, supplemented by the score on the final exam,

Most of the students who do not complete the course units in one semester persist into a second semester and eventually 70% finish and go on to the next course. In order to avoid the potential problem of student not knowing how well he/she is progressing, the staff post on the wall of the Learning Lab mimeographed schedules for every week of the semester indicating where a student should be if he/she plans to complete the course work in a semester. These schedules and charts are designed by Barbara Ann Bardwell, Instructor and Coordinator of the MMP. The statistics indicte that the Bishop College students are, in fact, learning more than just "some mathematics."

Bishop's MMP is now in its third year. It has undergone interim evaluation, and based on the responses from questionnaires and group discussions, the students approve the program and benefit from it. Of course, there are problems in the MMP, some acknowledged, others less apparent. More funds are needed to support a strong system of peer tutoring as evidenced by the students often giving up in frustration while waiting for help during the class period. The limitation on the usage of the computer terminals and other materials are a real problem. Some students feel that the course would be more interesting if these facilities were available.

In spite of the problems encountered, the department staff believes in, and supports the program. The spirit remains vital and innovative and new ideas and possibilities are constantly discussed for improvement of the program.

DEVELOPMENT OF SUPPORTIVE MATERIALS IN MATHEMATICS AND SCIENCE IN A LECTURE-LABORATORY FORMAT

Mahendra Kawatra and Darius Movasseghi
Medgar Evers College

Semi-Individualized Professionally-Determined Pace (SIPP) mode of instruction has been explained in a previous paper. The basic features of this mode are: (1) modularization of the course content, (2) self-paced learning with a set time limit for achieving the objectives, (3) instruction of a course in a lecture-workshop setting, thereby giving students the benefits of both the group as well as individual instruction, and (4) provision of a supportive system for an effective instructional process in the form of an A-V laboratory.

The modularization of the course and availability of this material in videotapes and/or audiotapes and the other ancillary materials is vital for instruction in the SIPP mode. For the most part, in the area of natural sciences and mathematics, these materials are not systematically available or are not of the desired quality and format needed to develop such materials in-house. In order to develop and organize the materials in an appropriate format and at a desirable level, the following steps need to be taken:

1. Identify the philosophy and the goals of the course within the framework of the discipline and departmental instructional program.
2. Outline the detailed content to be covered in attaining the goals.
3. Identify the learning deficiencies of the students related to the course.
4. Divide the contents into 8-12 self-sufficient modules.
5. Sub-divide each module into units such that the topics in each unit are closely linked together. (Generally, the total number of units in a one-semester course should not exceed 35.)
6. Identify and enlist the available resources, since a meaningful coordination of the instruction and the utilization of the resources is vital to the present mode.
7. Formulate diagnostic tests to determine students' attainment of the specified behavioral objectives.

It is important to note that writing a module, for the most part, is comprised of developing and organizing the materials for each unit. Therefore, it is essential to point out the necessary ingredients of such a task:

1. The behavioral objectives of each unit should be clearly delineated. That is, several short and precise statements of the desired measurable accomplishments and the mastery of concepts must be made.
2. The exit criteria for the accomplishment of the objectives should be clearly indicated (e.g., with 80% score on the test).
3. The prerequisite skills and cognitive information for the unit, if any, should be specified in simple language, and reference made to the appropriate modules and units.
4. Several forms of pre- and post-tests should be developed for the purposes of establishing whether a student needs to study the unit, and also to identify his strengths or weaknesses relating to the unit.
5. Description of the material for the unit should be done in an understandable language; introduction of new concepts should be highlighted, and the materials developed should involve student participation at all phases of development. It is important that examinations of comprehension be made periodically and frequently throughout the unit. This would ensure continuous participation of the student.

6. The length of a unit should roughly conform to 20-25 minutes of straight lecture. This length would ensure continuous attention of the student.
7. Post-test should specifically address itself to examining the achievement of the stated behavioral objectives.

Once the development of units in a module is achieved, they should be put together in a package which should also include (1) a general statement about the desired objectives of the module, (2) pre-tests and post-tests for the module, and (3) a prescription for the placement of a student in a certain unit or units depending upon his performance on the pre-test or post-test. The activities of a student in a module can be best illustrated in a flow chart. It is very important to note that the most vital decision in writing a module lies in the selection of appropriate instructional materials and the flow of activities in a manner suitable to the student's needs and abilities.

It is further desirable to mention here that there are differences of opinion as to whether the behavioral objectives be placed prior to the instructional materials (to provide the orienting stimulus) or at the end of the materials (to provide reinforcement). Our experience has shown that, at least in the areas of mathematics and natural science, the objectives should be placed at the beginning since the students, in general, already have some familiarity with the terminology used. Furthermore, in the SIPP format it is essential to have all the aforementioned material in a lecture form on audio-tapes as well as on the videotapes with appropriate ancillary materials with emphasis on problem solving.

The central problem of the present educational system has been its inability to preserve the intrinsic interest of the students in the learning process prior to their entry into a college. We feel, although difficult, it is of utmost importance that the mode of instruction in the delivery of material at a college be such that it attempts not only to alleviate the above problem but also it provides constant encouragement. It seems that we, through SIPP, have touched on such an approach.

VI. INTERDISCIPLINARY COURSES AND CAREER OPPORTUNITIES

On-The-Job Training of Students in Computer Science.
Ronald G. Selsby and Manuel Gomez-Rodriguez

An Interdisciplinary Seminar in the Behavioral, Natural and Social Sciences.
Clemmie E. Webber

Urban-Environmental Studies: An Interdisciplinary Approach.
Kathryn Brisbane

A Capstone Interdisciplinary Course in Values and the Sciences for the General Education Curriculum.
Sister Isabel Ball

Development of an Aquaculture Training Program in Alaska for Minority Students.
Mel Seifert

Internships: Achieving Linkages Between Scientific Disciplines.
Elmer L. Washington

Career Opportunities in Science.
Tae Y. Nam

The Challenge of Interdisciplinary Studies.
William J. Nelson

ON-THE-JOB TRAINING OF STUDENTS IN COMPUTER SCIENCE

Ronald G. Selsby and Manuel Gomez-Rodriguez
University of Puerto Rico, Rio Piedras

The Natural Science Academic Computer Center (NSACC), at the Rio Piedras Campus of the University of Puerto Rico, was established in order to: (1) develop, manage, and administer computer-assisted instruction (CAI), (2) process computer programs for students of the college, (3) provide a computer facility for professors, scientists, and graduate students to implement research projects, and (4) train students in the operation and management of a computer center as well as to introduce them to systems-programming, computer technology and its applications. We here report on the method utilized to attain the fourth objective and the results obtained. The key to the method is the on-the-job training of a student staff responsible for the management and operation of the entire facility. Five aspects of the training program are discussed: (1) motivation of students, (2) selection and training procedures, (3) the composition of the student staff, (4) identification of the problem areas, and (5) evaluation of the training process.

Motivation. All students in the College of Natural Sciences are required to take one semester of PL/1 Programming. In addition, students taking the basic courses in chemistry, physics, biology, and mathematics are strongly encouraged to use CAI modules which are available through the use of interactive CRT terminals at the NSACC. By the sophomore year, all students have had a chance to observe and interact with the facilities at the NSACC, including the HP-2000 Access System currently supporting 22 CRT terminals and an IBM Remote-Job-Entry unit (RJE) connected to the university's central IBM 370/148. The fact that the highly visible, sophisticated physical plant is managed and operated *entirely* by a *student staff* is the main source of motivation for students to enter and participate in the program. The motivation is sustained by hands-on experience with the extensive computer hardware and by participation in a variety of software application projects. The students are remunerated for work at the NSACC. Interest throughout the training program is sustained by the "esprit de corps" of the student staff.

Selection and Training of the Student Staff. The essential feature of the process is that selection is based on student performance in which self-motivation is the critical factor. Fully qualified members of the student staff are denoted as Operator-Programmer, Senior Grade. The steps leading to this senior status begin with the Programmer Trainees, who, as students having completed one semester of PL/1, are asked to learn BASIC by self-study. They are assigned a programming application project by one of the student managers, usually in CAI or in management of the HP or IBM system. Trainees become Programmer Junior Grade when they have demonstrated mastery of both PL/1 and BASIC, including the ability to make disc file manipulations of the HP and IBM systems and tape file manipulations on the HP. At this point, if they have sustained at least a 2.75 overall academic average, they are invited to work in the NSACC. Some choose to work for the undergraduate research projects, utilizing the computer skills. Those electing to work for the NSACC become Operator-Programmer Trainees. They receive on-the-job training as well as a compensation from the center for 5 to 10 hours of work per week. For the trainee to become an Operator-Programmer, Junior Grade, he must pass an examination given by one of the student managers which includes loading the HP operating system from disc and magnetic tape, signing on and off the IBM-RJE facility, knowledge of the operating commands for both systems, and the adjustment of the peripherals.

The final phase of the training, leading to the status of Operator-Programmer, Senior Grade, consists of a formal examination which has come to be called "getting wings." It is administered once a semester by the full senior grade staff. Passing requires unanimous approval of the student examiners. The exam covers all IBM and HP procedures essential for operation and recovery of the systems. The student is put under pressure simulating actual operating conditions such as a power failure or system software crash. The student is tested on the ability to maintain a cool head under pressure, protect the system hardware and preserve the system software. A tradition has been established by which students passing this exam receive a "wings" pin.

Student Staff Composition. Probably the most important role for the professor who directs a student operated facility, such as the one described here, is to keep a low profile as he acts as an advisor, guiding the students into slots which suit their personalities, talents, and professional objectives, while at the same time assuring a minimum of internal friction between them. Lack of this type of guidance can easily undermine the effective operation of the center. Thus, some staff are encouraged into managerial positions, where interaction with people is the principal ingredient, while others are encouraged to become "systems analysts", concentrating on technical matters. A Senior Grade Operator-Programmer concentrates on either management, systems-analysis, or application programming.

Currently the NSACC has 10 Programmer Trainees (mostly freshmen), 12 Operator-Programmers, Junior Grade (sophomores and juniors), and 9 Operator-Programmers, Senior Grade, most of whom graduate this coming June.

Identification of Problem Areas. In two years of operation we have been able to identify problem areas which, if left unresolved, will undermine the program. (1) The student staff tends to adopt a superior attitude towards the student users. The staff needs to be reminded that they are there to provide service. If the staff is encouraged to help the students, this problem tends to be minimized. (2) The senior staff is subject to a high level of internal competition leading to disruptive personality clashes. This may be minimized by removing as much vertical structure in the chain of command as possible. (3) Friction is observed to develop between professors and the senior grade staff. Here the director must act as a mediator, insisting that the student show the proper respect due a professor, while asking the latter to recognize the special status of the student staff. (4) It is absolutely necessary that the student staff not abuse their privileges. It must be remembered that they have the technical ability to obtain and alter privileged information. Ultimately, the director of the facility is responsible for the honesty and fairness of each member of the staff. (5) Finally, we have observed the motivation of the senior grade staff to peak before they graduate. We have compensated for this by continually challenging them with individual projects. One such successful project is the "Introduction to Computers Workshop" in which a staff member will invite a high school class to come to the center and will direct these students, each at a CRT terminal, through the workshop program.

Evaluation of the Training Program. Assessment after two years reveals that the student staff attains a strong background in (1) organizing and operating a computer center with interactive and batch processing modes, (2) a mastery of programming in 2 or 3 higher level languages and one Assembler, (3) job-control language, and (4) the development of computer application programs such as CAI.

The student staff has been found to be self-perpetuating, as newer members continually receive on-the-job training from the more experienced members. The student-run computer center operates in a continous and efficient manner on a relatively low cost budget. At the same time, we observe that the experience allows these minority students to develop self-confidence and a sense of accomplishment, as is evidenced by their pride in the center and their ability to enter graduate school in computer science or to obtain computer-related jobs in industry and government.

AN INTERDISCIPLINARY SEMINAR IN THE BEHAVIORAL, NATURAL AND SOCIAL SCIENCES

Clemmie E. Webber, South Carolina State College

Contemporary concern for excellence requires that institutions of higher learning plan and structure their education programs to provide unity, continuity, balance, and harmony. An objective review of curricular offerings at South Carolina State College, the Department of Natural Sciences in particular, indicated excessive fragmentation. As a matter of fact, investigation revealed few, if any, opportunities for integrated educational experiences, especially where open dialogue was a component. These findings stimulated much concern which led to an effort to relieve this situation. Thus, as one segment of a MISIP proposal funded by the National Science Foundation and later approved by the College as a regular course offering, this relevant interdisciplinary seminar has become a viable vehicle through which current, highly significant, science and society concerns and issues are objectively addressed.

The seminar, a one credit-hour course, which meets once per week, is a free elective open to interested juniors and seniors who are majors in the departments of the behavioral, natural, and social sciences. It is offered during alternate semesters and accommodates a maximum of twenty-six students, a number large enough to include significant representation from the several areas included in each of the participating departments. Experience has proven that a larger group of speakers is less effective.

A flexible format utilizing a variety of problem solving techniques and strategies in an atmosphere of informal discovery categorizes each class session. Major course expectations include individual participation based on extensive reading, experimentation, personal research and/or actual experiences which can be documented. All topics are selected and presented on the basis of their current significance as well as their interdisciplinary implications.

Faculty leadership is given the seminar by a team of three professors, each representing a different department and chosen on the basis of interest and a quality of expertise which would help foster enriched self-regulating learning experiences. Outstanding educators and knowledgeable faculty at South Carolina State College, the community, and from nearby educational institutions are invited as consultants or resource persons. These invited guests are frequently available for individual and small group conferences and laboratory direction. All who attend our seminar sessions are invited to respond to a written evaluation check-list.

Research problems cut across departmental barriers and involve consistent direction and faculty input. The seminar coordinator must be constantly on the alert for reports of interdisciplinary faculty and student research at this and other South Carolina colleges with the idea of inviting these researchers to share their findings. When research pursued by State or other government agencies proves germane to our emphasis, effort is made to have compatible phases presented as enrichment.

A major strength of the seminar continues to be consultant oriented. We have been most fortunate in securing the services of outstanding personalities representing a wide range of academic capability and excellent balance with respect to the disciplines identified for this course. In addition to the academic astuteness of our consultants, they have been particularly effective in their ability to relate to, and stimulate, student speakers. The dynamics and appropriateness of presentations made by several consultants have been of such magnitude that they have been invited as guests of a department or school within our college system.

"Bridging the Gap Between the Behavioral, Natural and Social Sciences: An Eclectic View of the Quality of Contemporary Life" has proven to be a challenging and effective umbrella for an array of current multidisciplinary issues. This has been the theme of the course since its inception.

Enthusiasm for the seminar is broadly expressed. To quote from several student evaluation forms, the following comments are noted: "This seminar has been one of the most rewarding courses I have ever had the opportunity to be a part of." "Each day added a new dimension to my thoughts and helped me to understand myself better." "I developed an open-mindedness that I did not realize was possible." "I realize that I gained more from this course than I contributed, although my verbal responses were few, this course aroused a new sense of awareness in me." "Most stimulating." "I never dreamed a course during my final college semester could make me spend so much time in the library and wish for additional hours." "What can be done to make this kind of course available to larger numbers of students?" Almost without exception student comments have been positive and in many cases challenging in terms of recommendations for college-wide benefits.

Much thought was given to the selection of provocative and popular topics for the current session. We will continue to use several unconventional approaches to learning as we attempt to help students make the transition from a single academic discipline approach to a more comprehensive interdisciplinary viewing of their world.

URBAN-ENVIRONMENTAL STUDIES: AN INTERDISCIPLINARY APPROACH

Kathryn Brisbane, Spelman College

Interdisciplinary courses were introduced into the Spelman College curriculum in the mid-1970's when a structural change occurred; that is, the college was divided into five divisions: Education, Fine Arts, Humanities, Natural Sciences, and Social Sciences. The structural change created an environment receptive to the new interdisciplinary thrust. This thrust was supported by the Social Sciences Division, and in 1975 the Division submitted a proposal to the National Science Foundation for an Urban-Environmental Studies Program which was funded. The purpose of these studies was to strengthen and broaden the curriculum.

A good interdisciplinary program called for the involvement of all the Social Sciences Departments in planning the new sequence of courses. Involved were the Departments of Economics, History, Political Science, Psychology, Sociology, and the Natural Science Division, The Department of History was not a recipient of the NSF grant but, as a part of the Social Science Department at Spelman, was involved and made an important contribution to the program's development. The intent of interdisciplinary studies was to break through the barrier among disciplines.

Since most interdisciplinary studies are built around specific themes or ideas which seem to lend themselves best to the problem solving method in its broadest sense, the social sciences faculty focused on the urban center and its attendant problems and issues, both ecological and environmental. The solving of these problems required the knowledge and skills of all of the social sciences and the subject was compatible with a liberal arts curriculum. Most important is the fact that black students and particularly black women have been at a disadvantage in their experience and limited knowledge of the structures and functions of urban government and urban environmental needs. Therefore, this was an appropriate theme.

Thus, the social science faculty attempted to integrate the contributions that the various disciplines made in solving a problem for understanding an issue or expandingon a theme. It meant, ". . . bringing interdependent parts of knowledge into harmonious relationships. It involved relating part to part, part to whole, and whole to part."[1]

Teams of the faculty members worked together to structure the sequence, organize content for eight new courses, and improve several of the traditional courses in the various disciplines included in the sequence of courses. Efforts were made to integrate into the traditional courses information pertinent to environmental issues which heretofore were the beneficiaries of the new knowledge.

New courses introducted were History an Ecology of the City, Environmental and Ecological Issues, Community Mental Health (a problem of great significance to blacks), Levels of Government and Legal Institutions, The Administration of the Urban Center, Urban Fiscal Policy and Public Finance, Urban Culture, and Urban Regional Planning. Examples of courses that were revised are Urban Economics, Urban Government and Politics. The courses were organized so that a student could begin the concentration in the sophomore year. Each of the disciplines charted the curriculum for its own department. The core curriculum and electives were to be followed by its students through the three years of concentration in the Urban-Enviromental Studies.

A number of innovations were introduced. For instance, the introductory course was designed by a team of seven faculty members and organized as an Independent Learning System type model. The syllabus included content divided into modules, topics for discussion, study questions, and unit tests. The course had six units, and students moved through the units at their own pace. This innovation has had success, and students found it easier to learn. This course was taught by professors in the Sociology Department. In addition to the lecture/discussion method, guest lecturers, simulation, and audio-visual media introduced a variety of teaching methodologies into courses taught within the Psychology, Political Science, and Economics Departments.

---

[1] Meeth, L. Richard. *Quality Education for Less Money.* San Francisco, Calif.: Jossey-Bass Inc., 1974.

As a result of the grant, a major development has been the Urban Culture Center (UCC) which has provided impetus for student/teacher research in the social sciences. The faculty is kept abreast of what is happening in cultural studies and techniques for identifying potential areas and themes for cultural research in Atlanta. The UCC serves as a classroom/workroom, a small library of urban ethnographic books and journals, a depository of commercial tapes and films, student-research films, tapes, transcripts and papers, field equipment such as tape recorders, video system components, cameras, projectors, and so forth, in addition to the files on topics related to Urban Studies.

The UCC opened in April, 1976 with a workshop designed to publicize the Center and for the purpose of discussing techniques of data collection and analysis of urban cultural themes. Outstanding consultants were invited to the workshop. The objectives of the Center have been for students to learn how to do research on communities and cultures in Atlanta using all of the equipment available to the UCC. It is through the UCC that students in the social sciences will be able to work on a variety of topics such as sex roles, juvenile gangs, business and labor groups, political structure, religious behavior, values, language, and public behavior in bars. The students will also study topics related to oral history and urban folklore—*Much history is locked in the memories of older residents. What a community thinks may be found in its jokes, riddles, proverbs, poetry, and word games.*

A summer workshop in the application of computer technology in the classroom was held for the faculty. The Center for Multidisciplinary Educational Exercises (COMEX) at the University of Southern California in Los Angeles provided ten faculty members with a User's Training Course. This was a first step in the plans for a faculty development program for the social sciences. Currently, members of the Economics, Political Science, and Sociology Departments are improving their skills in the use of the computer. A Sociology Department faculty member has guided one student through a senior thesis on an urban problem with research computations using the computer. We recognize that not all students can master the skills necessary for this kind of research, but those who are able will be better prepared for graduate and professional schools.

Three hundred and twenty-eight students have taken the course. Of this number, 20 have indicated a preference for the concentration and 12 have graduated with certificates. Efforts will be made to have the concentration declared a major. Collaboration by colleges in the Center should provide the strength needed for a full and viable major.These colleges include Clark, Morehouse, Morris Brown, and Spelman Colleges, Atlanta University, and the Interdenominational Theological Seminary.

The program has had an impact on the institution by creating an acceptance on the part of the social science faculty of Interdisciplinary Programs. The faculty has been helpful in assisting other divisions in developing courses. The cross-fertilization of ideas has been significant. Faculty and students have a greater awareness of the possibilities of computer technology in social science research. New teaching methodologies have enriched and facilitated learning in the courses. In the future, the Division expects to involve the rest of the faculty in a faculty development program which will upgrade their skills for improved teaching effectiveness.

A CAPSTONE INTERDISCIPLINARY COURSE IN VALUES AND THE SCIENCES FOR THE GENERAL EDUCATION CURRICULUM

Sister Isabel Ball, Our Lady of the Lake University

Our Lady of the Lake University (OLLU) has an undergraduate enrollment averaging 1,250 students. Over 65% of these are ethnic minorities (60% Mexican-American, 8%Black, and 1% Native American according to fall 1978 data). A large majority of these are interested in service-oriented careers involving a variety of disciplines.

The more or less segregated disciplines studied as general education often leave the student with a sense of fruitlessness. Even if fully appreciating a given course, the extravagance of such an experience leaves in the student nuances of subconscious guilt expressed negatively toward the course when regarding the service function for which he/she is preparing. The integration of science and social and cultural values by means of a capstone course in which the humanistic and philosophical questions about the role of science, both now and in the future, was proposed as a means of overcoming the seemingly—or perhaps not so seemingly—disjointed curriculum, and assisting the student in relating the areas of knowledge to himself/herself and his/her aspirations in a meaningful manner.

Further, this course fit well into the competency based, degree plan which OLLU espouses. Indeed, the competencies were grounded in the rationale given above and are expressions of the desired outcomes to be found in each OLLU graduate.

However, the course, as does any course, goes beyond the required competencies both in breadth and depth of coverage. And for that reason I will concern myself with the course in its totality rather than how the course fulfills the several competencies as OLLU states them for its degree.

The course was produced by a team of faculty during the summer of 1976 under the auspices of MISIP. The team was composed of a social scientist, a natural scientist, and a philosopher. Because the course was to be a capstone course, the team recognized early that there would have to be prerequisites to the course (otherwise, what would there be to intergrate?). though these would be limited and held to a minimum. However, prior to determining specific prerequisites, the objectives of the course were drafted. These turned out to be both cognitive and affective in kind and determined the prerequisites to be at least six semester hours each of natural science, social science, and philosophy. The objectives are as follows:

Cognitive

1. The student will be aware of the diverse approaches to values as sought in the various disciplines and arrived at by various clarification processes such that he can identify and discuss the different approaches.
2. The student should understand the interrelationship of science, technology, and man, historically noting the extent and change-rate dimensions as they affect man's dependence and vulnerability, his future, and responsibilities so that he can synthesize a complete picture for use in making evaluations of scientific and technological advances.
3. The student should understand the multidimensional aspect of technology on life including the futuristic, global, institutional, and individual facets so that he can fairly and consistently evaluate the technological impact in written and oral discussion.
4. The student should understand the philosophical issues in scientific discoveries and technological innovation such that he can relate them to the nature of man, the purpose of human life, and the nature of good human life and good human behavior in a consistent manner.

Affective

1. The student should want to examine personal and societal values in terms of philosophical questions, such as, "What is the purpose of life?" "What is the nature of man?" and "What is good human life?"
2. The student should gain an appreciation of science and technology.
3. The student should gain a desire to discuss technology, to interact with information provided, and to form and express one's views on it.
4. The student should become concerned about the global and future effects of technological decisions, acknowledging some responsibility for them.
5. The student should want to know more about new technological developments.
6. The student should feel a sense of urgency about dealing with the problems of technology.

Before launching an effort to write a completely new set of materials for the course, the team searched library holdings (including the Media Learning Center), publisher's catalogs, and their own and colleagues' offices and brains for appropriate materials and ideas. Media, which held promise, were ordered on approval and assessed for their usefulness. Where books, films, slides, etc. were considered germane, they were purchased with MISIP funds and incorporated into the course. The major portion of the team's time was spent writing a syllabus keyed to a bibliography of all the materials which were found.

New material which was needed happened to be minimal but was key to the approach in which the course was intended to take. Because it was envisioned that perhaps the team or its individual members might not always be the instructors of the course, it was important that any qualified instructor be able to teach it as designed. This was important because the syllabus alone could be misleading. Simply covering the syllabus material did not teach the student to evaluate something on the basis of the diverse approaches of the disciplines, and to make and defend choices with the insight into what it means to be human in a time of ever increasing scientific and technological discovery. An introduction and several charts were composed primarily for instructor usage as an aid to insuring the desired approach. Further, teaching methods were suggested since they seemed influential in achieving the desired student learning.

The team suggested that considerable group discussion be used to achieve the kind of multidimensional thinking required. Some of this was to be done in a small group before the class, sometimes including the professor team, and sometimes cassette recorded in the absence of class or professors. Additionally, discussion by the individual in written and recorded form was to be used. The students would, hopefully, develop other perspectives by listening to those who have backgrounds other than their own. This seemed appropriate methodology for assisting students to think more broadly and synoptically. Finally,the team wrote some assessment items, an evaluation instrument, and set criteria and standards for assessment.

The protocol followed in putting the course together was for individual team members to work on assigned areas, then to assemble to assess and discuss their products. A team chairman coordinated the work and the meetings. A curriculum consultant, available on campus through FIPSE (Fund for the Improvement of Post Secondary Education), rendered assistance from time to time, especially in the beginning of our project.

Since the course has been in the curriculum, it has been scheduled three times but offered only twice. Enrollments have been very small and too costly to warrant team (three professors) teaching. Consequently, variations have been employed. In May 1978 it was taught to four students by independent study. All three professors were present for specified discussions and all three evaluated taped discussion among the four as well as individual papers and examinations. The present, spring 1979, version has eleven students and is being taught primarily by one professor with the others guesting individually in person and as an interacting team via videotape cassette. Only 50% of all student work, including exams and major projects, are being team evaluated.

At this time it is impossible to evaluate the effectiveness of the course. The four students who have completed the course considered it extremely worthwhile though terribly time consuming. They did not find the team approach helpful but, of course, it was not functioning as designed. We, who wrote the course, and the administration who commissioned it, consider it a valuable addition to the curriculum and feel the team approach is the best way to teach it. Although somewhat hindered in our original plan, the team believes it has managed to present a beneficial and significant learning experience for those who have enrolled.

DEVELOPMENT OF AN AQUACULTURE TRAINING PROGRAM IN ALASKA FOR MINORITY STUDENTS

Mel Seifert, Sheldon Jackson College

Sheldon Jackson College (SJC) is the oldest educational institution in Alaska. Located on a large island in the remote wilderness of Southeast Alaska, 900 miles north of Seattle, the institution began as an industrial training school for Tlingit Indians in 1878 and served Alaska's Eskimos and Indians almost exclusively until the last decade or two. Now, about 60 - 65% of the FTE (Full Time Equivalent) students are Native Alaskans. The primary lifestyle backgrounds of these Native students are commercial and subsistence fishing. The Alaska Native Land Claims Settlement Act is providing them with necessary land and capital for salmon enhancement programs. Thus, because of the traditional lifestyle and new career opportunities in fisheries for Native Alaskans, SJC initiated the first, and only, applied aquaculture program in Alaska in 1975.

The program was designed to promote Native Education by providing a career ladder for Indians, Aleuts, and Eskimos interested in learning a practical and meaningful vocation as fisheries technicians. To provide the necessary training for this vocation, an appropriate curriculum was developed and a commercial salmon hatchery was established on campus. A total of 44 students completed all or part of the program during 1975-77. In 1978, 40 students, of which 23 (57%) are Native Alaskans or Indians, enrolled in the program.

The fisheries curriculum offers options of a one-year certificate in salmon culture technology, a two-year certificate in fisheries science technology, an Associate of Science degree, or a transfer program to higher education. Lateral movement from certificate to transfer program or vice versa is also possible.

A commercial size salmon hatchery capable of producing 10-15 million fingerlings per year has been constructed on the Pacific coastal shore of the campus. The successful large return of adult salmon in 1977 indicates that the financial goal of self support for the academic program may be feasible when returns are consistent. This hatchery and related freshwater-seawater facilities provide on the job type training for the students from the time of egg take in August to the period of fry release in May. The College owns a 38-foot vessel and several skiffs which are used extensively in fisheries and marine science activities. Utilization is made as much as possible of the natural resources of the area for field training in streams, lakes, and ocean estuaries.

Sheldon Jackson College has an "open door" admission policy. This results in classess of students with educational abilities ranging from those who need remedial help in math and communication skills to those who already have a college degree. This diversity of abilities could be a problem if approached in a typical classroom lecture atmosphere. The instructional methods used in the SJC program attempt to take advantage of this diversity by stressing cooperation rather than competition. Group assignments is one method that fosters cooperation and allows students with various types of expertise to help each other. This help is not all one way, however. Students who may be deficient in some basic academic skills often have knowledge of related vocational skills which can provide them with feelings of success and accomplishment by virtue of becoming the instructors.

Concern about competition with fellow students is eliminated by stressing competency-based instruction and grading by percentage. Final grades can be determined on a cumulative point basis from results of projects, reports, and exams. These various requirements can be repeated by the student until properly done or correct. Those that are repeated are limited to a top grade of C but each becomes a learning tool and not a threat. Some exams are oral and in individual session with the instructor. This reduces the bias in cultural background problems of understanding the test question words written in English.

The cultural background of Native Alaskans has never in the past stressed competitiveness or individual aggressiveness for self-attainment. This attitude has been greatly influenced by association in more recent years with the white culture but is still present. Our instructors have to be sensitive to those students who may feel embarrassed to be called upon individually, especially during their early period on campus. This attitude usually decreases as the instructors and students become better acquainted, and one of the best methods we have found is to involve everybody together first thing in a physical, non-academic project. Our students must arrive on campus 10 days earlier than all other SJC students in order to be there when the salmon are returning. We all work together taking eggs for the hatchery as part of their training. Thus, by the time formal classes begin, the fisheries students are well acquainted with each other, the instructors, and the school without immediate potential or conceived pressures of school work. They develop an "esprit de corps" among themselves and that, coupled with a definite vocational goal, helps carry them through other phases of their college program.

To help guide the program directions, a technical advisory comittee composed of educators, Native groups, students, and representatives of government and private fishery-related agencies meet once each year. The program is further evaluated by students, feedback from graduates about their preparedness for work or higher education, and their acceptance by fisheries employers. To date five Associate of Science degrees, 10 two-year certificates, and 20 one-year certificates have been awarded among forty-four students who have completed all or a part of the program requirements.

The program has accomplished its four year goals of establishing a vocational curriculum emphasizing on the job training and establishment of returning salmon runs to begin paying for itself. Recruitment of Native Alaskans into a science based vocation is closely tied to motivation which in turn is highly influenced by the lack of models within their particular cultures. This problem must be constantly addressed.

INTERNSHIPS — ACHIEVING LINKAGES BETWEEN SCIENTIFIC DISCIPLINES

Elmer L. Washington, Chicago State University

The specific areas of interdisciplinary courses and career opportunities have been of significant concern at Chicago State University since 1972. At that time, the university was beginning to emerge from its origin as a teachers college, the chief supplier of teachers to the Chicago public schools, to a multi-purpose urban university. Concurrently, the population of Blacks was becoming a majority in the student body. It was apparent that the science departments had to take definite steps to achieve the two general goals of making their science programs more attractive to minority students, and of ensuring that the graduates could enter high-level, professional careers.

The programs described in this report enabled the university to more rapidly achieve the above goals. Specifically, the MISIP grant supported the following activities:

1. The development of a computer science program utilizing extensive input from industrial and academic consultants.
2. The development of a forensic science program based on cooperative efforts between the chemistry department and the Joliet Laboratory of the Illinois Bureau of Identification.
3. The enhancement of the pre-health professions program through course and internship development.

The computer science program was first initiated as an option in mathematics in 1975. During the past three years this program has grown so rapidly that last month the Illinois Board of Higher Education officially approved it as a full degree progam. The program includes two options: (1) General Computer Science, or (2) General Data Processing.

The first option is primarily oriented toward students who are interested in graduate study, while the second is directed toward students seeking full-time employment in industry. Each option provides for 27 hours of electives in which a suitable internship may be provided. Internships have been arranged at Argonne National Laboratory, Illinois Bell Telephone Company, Chicago Board of Education (Department of Systems Analysis and Data Processing), Board of Governors Cooperative Computer Center, and Chicago State University (Education and Evaluation Office, and the Office of Admissions and Records).

Not only do these internships make possible more extensive use of available resources, they also provide the department with a basis for relevant course development which gives unique exposure for students in areas such as teleprocessing, data base management, systems design and analysis, use of COBOL and Assembler Language, and direct applications in research activities. Based on the exposure in courses and in internships, students gain a better understanding of basic mathematical concepts as well as learning how these concepts relate to the data processing industry. The greater the student's exposure to different scientific disciplines, the more competitive he/she is as a computer scientist.

The forensic science program also typifies the kinds of internships that are the most beneficial to students. A single student was selected to spend eight weeks at the Joliet Laboratory of the Illinois Bureau of Identification. Learning objectives and administrative details of the program were established in consultation with administrators and investigators of the Bureau. The internship carried seven hours of credit, 36-hours/week for 8-weeks. The student was supervised by practicing forensic scientists and exposed to laboratory techniques for the investigation of physical evidence in criminal and civil cases.

During the eight-week period, the student worked in six departments of the Bureau. They included Serology (seven days), Chemistry (seven days), Instruments (seven days), Photography (seven days), Polygraph (two days), and Latent Fingerprinting (six days).

In each of the above areas, evaluation of the student was based on investigative skills mastered or assignments completed. In the overall evaluation of the intern, quality of work, quantity of work, promptness, dependability, ability to follow instructions, ability to work with others, and academic preparedness were all taken into consideration.

It is noteworthy that our first student ranked good to excellent in every category. Not only did the student have to draw on knowledge of different disciplines in each of the component parts of the internship, he also had to rapidly learn the basic operations in each unit. The program was viewed as a success by all participants. It is to be used as a prototype for a state-wide model to utilize the Joliet Laboratory facilities in upgrading the training of forensic students.

Similar internship exposures have been developed between Chicago State University and the Rush University Medical Center for pre-health professions students. In this program, CSU students were interviewed and placed in suitable positions based on evaluations by selected CSU faculty members in biology and chemistry. The Assistant Dean of Instruction at Rush University also assisted in the placement process, obtaining progress reports, and in evaluations of student achievement. During the period of the MISIP grant, three students participated in this internship program. Since then, four additional students have enrolled. All students who participated in the internship exhibited high enthusiasm and did excellent academic work, but the success of each student is significantly dependent on the extent of his/her mastery of the traditional undergraduate disciplines.

CAREER OPPORTUNITIES IN SCIENCES

Tae Y. Nam, University of Arkansas, Pine Bluff

The University of Arkansas at Pine Bluff is located in Jefferson County, where 43.9% of the total population of 92,015 is black. The immediate city of Pine Bluff which is the state's fourth largest city has a population of 62,115, of which 39% are black.

Agriculture in Jefferson County is predominantly carried on in the Delta area, east of the Arkansas River. Within the county more numbers of minority families (51.4%) have a higher incidence of poverty than the population as a whole (23%).

It is from this Jeffersson County-Pine Bluff area that the University draws about 50% of its student body. Of the 2,999 students (1978), 87% are black, 12% are white, and 1% are of other races. More than 90% of these students receive some form of financial assistance.

Service-learning internship has two basic goals: (1) "service" to provide increased manpower for short-term research and assistance and to create means of identifying highly-qualified students and attracting them to careers in government and public affairs, and (2) "learning" to develop experiential education, i.e. to combine formal education with experiences in which the student undertakes practical, consequential activities and assumes new responsibilities. In order to achieve the goals, the political science program, first officiated in 1975, provides a curriculum, "Internship in Political Science" yielding three credits. Likewise, "Internship in Economics" and "Field Experience and Seminar in Sociology" each provides three semester hours credit to the advanced juniors or the graduating seniors who have demonstrated academic excellence by earning a grade point average of "B" or above. The main objectives of service-learning internships are: (1) to conduct a county-wide internship feasibility study, (2) to hold conferences with outside consultants, (3) to conduct public administration seminars, and (4) to place service-learning interns.

Beginning the fall semester of 1975, an internship feasibility study was undertaken. First, 235 questionnaires (with self-addressed envelopes) were sent to all executive heads of public agencies located in Jefferson County. Secondly, a follow-up survey (95), which was jointly sponsored with the UAPB/Industry Cluster Task Force on Proposal and Curriculum Development, was conducted to determine curriculum preference of the employers. The first questionnaire was directed essentially to the public agencies while the second one went to the private industries. Subsequent to these surveys, a field survey was conducted by interviewing the prospective internship host agencies by a team of student research assistants.

Consultants invited to the University for service-learning programs were Dr. Tobe Johnson, Director of Urban Studies at Morehouse College, Dr. Wylie Davis, Dean of the University of Arkansas Law School, Ms. Vashti Varnado, Assistant Attorney General of Arkansas, and Dr. Charles Harris, Chairman of the Political Science Department at Howard University.

Nine public service internship seminars were held in the month of June, 1976 in conjunction with a summer course on public administration offered by the Department of History and Political Science. The seminars were publicized to promote attendance by the public, students, faculty members, and representatives of public and private agencies in the hope of promoting the idea of internships by the undergraduate students for the study of theories and practices of public administration by the participants and encouraging the minority students to seek careers in administrative strata.

The participants (both students and the public) in the seminars had options of either auditing the course or receiving three credits. The lectures were presented in various formats such as seminar-type, forum-debate, or regular lecture.

Since the foundation work for the internship program was well grounded in the first year's operation of the grant, six students were enrolled in internships in the second year of operation. Their service-learning averaged 12 hours per week, for which they received three academic credits.

As a result of these experiences, we have now developed standard forms for Internship Agreement and Intern Evaulation. Further, a standard procedure of evaluation to award academic credits to interns has been developed. Two internship report papers, internship faculty advisor's field inspection, and the objective work performance evaluation by the intern's work supervisor, have been formulated by the three coordinators of each discipline.

Beginning the fall semester of 1978, we have programmed 20 full-time internships per year in political science and agriculture disciplines.

1. *Political Science Area*

Of the ten intern students projected for the 1978-79 year, eight students will be placed for the current spring semester, with the remaining two students for the summer and fall periods.

With regard to the "learning" aspects on the part of the students, our focus is on two basic areas: public administration and legal training. This is reflected in our selection of participating agencies like the City Attorney's office, the two County Circuit Judges, and a Juvenile Judge, the Sheriff's Office, the State Correction Department, the Congressman's office, two Mayor's offices, and the Superintendent's office of a school district.

2. *Agriculture Area*

Of the ten students to be assigned in the agriculture area, six will go into the program during the spring semester with the remaining four students for the summer and fall of 1979. The thrust of the agricultural sector of this project will be centered around up-grading the income potential of specific small farmers via trainee-farmer participation in the Southeast Arkansas district, specifically, those associated with Vegetable Market Incorporated, located at Pine Bluff, Arkansas.

All six intern students for the current semester will be assigned to the Cooperative Extension Headquarters, Jefferson County. These students are expected to affect about 50-60 individual farmers in the County.

THE CHALLENGE OF INTERDISCIPLINARY STUDIES

William J. Nelson, Paine College

The following is a description of a program/presentation given to social science students at Paine College in Augusta, Georgia in the fall academic quarter of 1978. This program/presentation consisted of lectures to selected groups of students and depicted a social problem from the vantage point of several disciplines. The idea for this originated when I noticed that most cultural anthropology books deal with many social problems in a fashion that, though not overly lengthy, exhibits a succinct insight and understanding of the described situation that many strictly sociological works do not.

That Paine College students need to know some elemental principles of race relations seems to be a reasonable enough assumption. It is a small, predominantly Afro-American college located in the heart of the Deep South. Moreover, the small college setting provides a backdrop in which the interdisciplinary framework can be optimally utilized: 1) classes are small, 2) many students look upon their professors as "Jacks of all trades", 3) students are encouraged to take courses outside their own major, when possible, and 4) "departments" frequently consists of, not separate disciplines, like sociology or psychology, but clusters of disciplines (Paine has, for example, a department of Social Science and Business Administration). The combination of the need for an understanding of U.S. race relations and the small college setting at Paine led me to design a standard presentation given to several Social Science classes in the course of the quarter. Following the presentation, I distributed follow-up questionnaires requesting reactions to the presented information. The presentation, "Race Relations in the United States", seems to be a popular topic. Pierre van den Berghe estimates that "for every 100 published racial attitude studies done in the United States we could find perhaps five to ten in all the rest of the world". Most Afro-American students are well aware of racial attitude information printed in most sociological periodicals and texts as well as that which comes out in the popular media. This information usually highlights such things as 1) Afro-American deprivation, 2) white oppression, 3) existence of a black world-wide culture, 4) the assumption that things should be changing and, concomitantly, that there are evil whites (many of them middle and lower class) who want to stop all the progress, and 5) Afro-Americans should be cared for by government and other agencies.

Most Paine students were found to be quite ignorant of any axiomatic principles of race relations. The following is a description of an interdisciplinary presentation designed to help Paine students look at U.S. race relations in a more objective light using principles from the following disciplines: biology, economics, statistics, and psychology.

Biology would not seem to be an appropriate area in which to provide insights into U.S. race relations until one recognizes that the U.S. population is divided into two color castes, with virtually no marginal group in between. Most other "non-white"groups are neither numerous nor powerful enough to affect the basic antagonistic relationships between blacks and whites. Biology, indeed, has an impact on maintaining the continuance of the U.S. system of race relations. In the U.S., any person with any known African sub-Saharan ancestry is classed as black, regardless of ethnic or cultural considerations (with Hispanics as the one exception). For example, a story is told of a woman who lost classification as white because she was 1/32 black.

With this type of arrangement, the two groups will exist at odds in perpetuity. More importantly, race will continue to be the sole method of continuing to differentiate the two castes. Racial intermarriage could provide some coming together, but African ancestry is ferreted out in the U.S. and this certainly does not promote intermarriage nor does it promote any intimate social activity (in schools, for example) of any kind. In the U.S., racial membership seems to be more important than nationality.

Economics, to many historians, provides a valid interpretation of U.S. race relations since the inception of colonization. Here again we use relations between blacks and whites. The question one would ask here is, "Why would discrimination of 10% of the population by 85% or more persist in a nation that has, materially, more than enough to go around?" The South Africans at least have an excuse—they're fighting for their lives. The answer to the preceding question, to many economic historians, has been simple—to co-opt poor whites. Racial discrimination serves to provide what meager status there is for many low and middle income whites. Upper class policy makers, anxious that poorer whites do not question the privileges of the upper class, seek to provide for a continuation of this attitude. Jim Crow was the result of such an effort. Other race relations specialists, utilizing points of view influenced by economics, have made similar notations of the present and past U.S. race relations paradigm.

Statistically, U.S. blacks are much more worse off than U.S. whites. This does not even require documentation since there is a consensus among virtually all writers in this area. The questions we pose for the statistician revolve not around the statistics themselves, but the use to which they are put. Anyone who aspires to work with statistics should have a keen awareness of the fact that gathering data occupies only a minute part of the entire statistical process. How are the statistics to be used? Does the above set of statistics influence or affect ongoing personal relations between U.S. blacks and whites? Does a black college president in a rigidly segregated city begrudge a white garage mechanic? We are obviously not talking about statistics as a detailed science here, but we are talking about the degree to which statistics become more than their numbers and start to become entities in their own right.

Psychology does not need an introduction as having bearings on the study of U.S. race relations. The psychology of race relations can take many forms, but for now, let us settle on a psychology that examines and takes into account the feelings blacks have for each other as an ethnic group. What are the unifiers of blacks (in a personal sense) as opposed to other ethnic groups?

The information immediately preceding, with slight variations, was presented to Paine students in order to look at a common social problem in a different light but, more importantly, to encourage them to look for and demand courses that deal with holistic and not narrow interpretations of human reality. More than 90% of the students agreed that interdisciplinary courses should be offered and over 85% expressed a resultant curiosity of other disciplines. In implementing the MISIP grant for the NSF, one of our mandates was to restructure the curriculum. To a large extent, this has been done; the restructuring that has been done has had an implicit justification. It was the intent of the project just described to provide a justification for what I believe to be the last major alteration of the sociology curriculum that is needed: the formation of an interdisciplinary course.

VII. GENERAL INSTRUCTIONAL STRATEGIES

What Does Piaget Tell Us About Teaching Science?
George Oleh Kolodiy (Presented by Mary Abkemeier)

Strategies in Science Instruction in a Junior College Setting.
Bettaiya Rajanna

Instructional Strategies in the Natural Sciences.
Ajeet S. Randhawa

Application of Techniques and Technology to Social Science Instruction.
Thomas Ray McAllister

Integration and Interfacing of Instructional Technologies—The Application of the Principles of Learning Theory to Instructional Design.
Frederick Dumser, Jr.

Using a Videocassette System as a Part of an Effective Instructional Strategy.
Timothy Hunt

Culture Sensitive, Quality Science Education at Navajo Community College.
Carl Hi[illegible]

The Use of Programmed Units and Learning Objectives in an Experimental Psychology Undergraduate Class.
Lendell W. Braud

WHAT DOES PIAGET TELL US ABOUT TEACHING SCIENCE ?

George Oleh Kolodiy, LaGuardia Community College
(Presented by Mary Abkemeier)

As a physicist, Piaget's theory of mental development appealed to me because it was directly related to the cognitive processes involved in understanding physics concepts and solving physicsproblems. Piaget's scheme for mental development is summarized in the following statements:

1. Cognitive growth proceeds in discrete stages.
2. These stages occur in the same order for all individuals and are the result of both maturation and the interaction of the mind with the environment.

Each stage is characterized by the ability to perform certain mental functions and an inability to perform others. The four principal stages in the mental development of all individuals, as outlined by Piaget, are divided as follows:

(1) Period of Sensorimotor Intelligence (0–2 years),
(2) Period of Preoperational Thought (2–7 years),
(3) Period of Concrete Operations (7–11 years), and
(4) Period of Formal Operations (11–? years).

During each new stage the individual becomes capable of behavioral patterns which he was incapable of in the previous stage.

As a college teacher, particularly as a physics teacher, I am concerned with the formal level of thought because the understanding of physics concepts and solution of many physics problems are geared toward this type of thinking. What *is* formal thinking and how does it differ from concrete thinking? Simply, the concrete operational person can think logically, but can only apply his logic to concrete (real or observable) situations, whereas a formal thinking person can deal with hypothetical problems. When confronted by a problem, he visualizes all possibilities and systematically tests each one, isolating and controlling variables as needed. Studies that attempt to determine the cognitive level of students usually consist of tasks presented to a student. Analysis consists of a one-to-one dialogue between the student and the person performing the task.

Studies that the author was involved in at Rutgers and other institutions attempted to ascertain the mental level of college students. Almost without exception, they all showed that less than 50% of college freshmen were at the formal level. In one particularly interesting study, we attempted to see whether differences existed among four levels of students in science courses: high school, university freshmen, inner city community college freshmen, and university seniors.

The results showed no significant differences among the first three. A follow-up of the students in this sample indicated that the higher level of the seniors was probably due to the attrition of non-formal students. Interestingly, there were no differences among white (basically Rutgers) freshmen and minority (Essex County College) freshmen. However, there was one difference between these two groups—technical vocabulary—which was shown by the nearly universal incorrect usage of such words as tension, torque, slope, sine, work, friction, etc.

We also attempted to find out whether there was any correlation between mental level and college grades or SAT verbal and math scores. As expected, significant correlations were found between the cognitive task scores and SAT math scores. However, there was no correlation between the cognitive task scores and college grades. College grades were, however, correlated to SAT verbal scores. Grades are apparently related to the ability to verbalize answers. This is particularly true if a non-formal student is confronted with formal subject matter where he must resort to meaningless memorization of conclusions and problem-solving methods.

How does the cognitive level of a person change? In Piaget's picture, when a student is presented with a situation in which his patterns of reasoning lead to expectations that are not confirmed, the stable state of mind is upset and he may reach a state of mental disequilibrium that may eventually lead to a higher level of thought. The way to enhance situations that might be beneficial in promoting cognitive development consists of placing him in these critical situations. Peer interaction is extremely important because his peers are functioning at levels close to his own.

One of the possible implications of the above analysis is that culturally deprived students lag behind culturally advantaged because of the absence of these situations. Among other things, the classroom must serve as a laboratory where cognitive conflict may be induced. The implication is that the traditional, lecture-recitation method is an inefficient learning technique for all except the very highest level of students and that thinking might best proceed via a more even balance of thinking, talking, and listening. The realization that the typical college class consists of two subgroups who employ different learning and problem-solving strategies may explain the bimodal distribution of grades that many tests yield.

For a few years I have been attempting to implement some of the above ideas into curriculum development. Generally, the approach has been twofold:

1. General classroom structure which utilizes physical experience and peer interaction and
2. Presentation of concepts in a manner accessible to the concrete level student.

Examples of (1), above, are inquiry-type activities which may be done in the lab or sometimes in the lecture. For example, an activity I always use in my physical science class when introducing the metric system consists of handing out blank measuring tapes to groups of students and asking each group to measure the dimensions of some object. Different strategies are then compared and eventually the students themselves construct the metric system on the blank tapes. Similar strategies are employed regarding measurements of area and volume, density and acceleration. In my lectures I constantly pose a concrete problem and let students discuss various solutions among themselves.

When our college received a MISIP grant last year, this gave me an opportunity to develop some of the ideas for (2), above, and incorporate them into a General Physics course. First, the General Physics course sequence was increased from the normal two to three semesters. Second, realizing that non-formal students will not be able to learn as much of the material in my lectures, simply because the mode of presentation was not geared toward their cognitive levels, I have either purchased or produced a complete set of audio tutorial lessons (cassettes and workbooks) which serve to provide remediation, reiterate my lectures, and work out further examples. These serve as a complete out-of-class support system for the course that may be utilized by the students that need them.

In order to facilitate maximum usage, the General Physics I course (which is Mechanics) has been divided into seven modules. At the beginning of each module the student is presented with a set of behavioral objectives, homework problems, and a list of audio tutorial resources. Each module is followed by a test. The course is not self-paced in the usual sense, but students may not proceed to the next modular test until they have passed the previous test. Tests can be made up at specified times outside of class. A chart showing everyone's progress is posted in front of the class during the lab period. Hopefully, this eliminates some of the procrastination. If a student fails a test, he is assigned to either some of the remedial or other audio-tutorial material. Two student aides are used as helpers in grading tests and helping students with the laboratory. In addition to the modular tests, mid-term and end-term exams are given. These may be taken by all the students no matter what module they have reached.

Some of the advantages of the above method are that students are permitted a different mode of learning without eliminating the lecture. The lecture is still there for those students who benefit from it, and most importantly, students are not permitted to drift along throughout the course without learning anything, as often happens. If they do not learn a particular topic, they are immediately stopped in their progress and are forced either to learn the material or drop out of the course.

STRATEGIES IN SCIENCE INSTRUCTION IN A JUNIOR COLLEGE SETTING

Bettaiya Rajanna, Selma University

Gagne[1] defines learning as a change in human disposition or capability which is not simply ascribable to the process of growth. Humans have a natural, inherent, instinct for learning. This presentation deals with certain basic precepts of learning and, some of the instructional strategies that could possibly accentuate the student's efforts to learn better and more effectively.

Selma University (S.U.) is a predominantly black private junior college located in the central part of Alabama. The majority of our students hail from socio-economically poor households. They have a mediocre high school science background. Some of these students have an inherent capability for achievement in natural sciences, but are reluctant to choose science because of the strongly nurtured notion, "Science is hard, not for me." Motivation to learn and a strong urge to achieve are conspicuously lacking because they suffer from a poor self concept.

Our first task was to identify suitable instructional strategies that will bridge-up the inadequacies in their high school science experiences, and to prepare these students to cope with college level science instruction. We emphasized two aspects of learning: a) the learner, and b) the environment. All instructional strategies at Selma University were developed to achieve Bigge's[2] learning principles: a) improving motivation, b) increasing efficiency, and c) improving retention. Our faculty is cognizant that effective learning occurs when learning is perceived by the student for his/her own purposes. Brief descriptions of some of the instructional methods that are under trial at Selma University are detailed in the following paragraphs.

Personalized Instruction

As part of Personalized System of Instruction (PSI), we developed one course each in General Biology and Physical Science as PSI courses. Biology was offered to 100 first semester freshmen (five sections of 20 students each taught by three different instructors) and physical science to 20 first semester sophomores (one section).

To our observation, PSI courses with teachers in passive roles were not very effective. This was because PSI being a passive instruction tool, can only be as effective as the user's capabilities, interest, and urge to learn which was lacking in the majority of our students.

However, the learning response of the students was greatly improved when PSI courses were modified by emphasizing the active role of instructors, classroom instruction (lectures), and supervision of the students' learning activities. Instructional materials were carefully selected. Well motivated and academically conscious students had better luck with conventional PSI.

Student-Student Tutorials

Dr. Derek Bok[3], President of Harvard University has remarked that, "Students learn as much from each other as they will from the faculty, from examination and books. . . they will have a richer educational experience learning from each other than they would otherwise." Scholastically high achieving sophomore students were selected as student tutors in math, biology, chemistry and the physical sciences. Students who had problems comprehending classroom lessons were assigned to these student tutors. The whole program was monitored by faculty of the respective courses. The results were very encouraging. Over 95% of students who attended these tutorials did very well in regular course works. However, it takes constant persuasive efforts to make students realize the importance and necessity of tutoring to upgrade their transcripts. Providing wages for these student tutors may be a problem in some instances.

---

[1] Gagne, R.M. (1965). *The Conditions of Learning.* Holt, Rinehart, and Winston, Inc. New York.

[2] Bigge, M.L. (1971). *Learning Theories for Teachers.* 2nd Ed. Harper and Row, New York.

[3] This is a quotation from Dr. Derek Bok's Press Conference, *Meet the Press,* Americas Press Conference of the Air by NBC Network, volume 20, number 48, Sunday, November 28, 1978.

Learning By Experience

Motivation in students could be achieved by adopting the activities students liked. There is an unlimited scope for this method in all areas of science. An alert teacher can easily command the attention of students by designing innovative science laboratory activities. Laboratory experiences in biology were included in this category. Occasional use of audiovisuals added strength to laboratory experiences. Students showed interest in listening, seeing and doing. Significant learning was acquired through active participation in the learning process. This instructional method was very effective particularly with freshman students. All the laboratory lessons were rewritten to make the students feel at ease.

Investigative (Laboratory) Assignments

This program was offered during the Fall 1978 to promising sophomore students. The program provided an opportunity for the students to design, carryout, and report on simple scientific investigations. Laboratory research problems, research term papers (mostly literature survey), seminars, etc., were offered to selected students as special assignments. This was a student centered activity. These assignments provided students with learning experiences such as working on scientific problems of their interest, learning how to use scientific method, using library materials, and also presenting their work to their peers in the setting of a quasi-professional meeting. Beginning January 1979, S.U.'s participation in NIH-MBS research program will make this instructional strategy more motivating toward creating an interest in students to pursue scientific careers.

Creative Problem Solving

Creative problems designed to sharpen-up students' creative thinking and decision making ability will rejuvenate new creative ideas and prepare them to deal with a variety of conflicting situations. During laboratory sessions instructors defined problems and solicited students' views of the ideal solutions. Every student's view or thoughts, however unrealistic or impossible they might be, were encouraged in the beginning. This was done in order to foster new ideas, sharpen-up their decision making ability, and develop confidence in them to deal with conflicting situations. All the students were given a chance to express their ideas. To our amazement we found many of the "quiet type" students contributing brilliant ideas.

At Selma University, the faculty are constantly experimenting with various instructional ideas and strategies to motivate, increase efficiency and retention of students in the sciences. However, we believe that the role of the instructor as the central figure who inspires and encourages students is more important than the strategies or learning materials. An instructor becomes an integral part of the learning environment. He is the one who programs the learner's environment and a learning strategy will be only as good as the programmer. In brief, a poor teacher complains, an average teacher explains, a good teacher teaches, and a great teacher inspires.

INSTRUCTIONAL STRATEGIES IN THE NATURAL SCIENCES

Ajeet S. Randhawa, Voorhees College

Most of us are familiar with the traditional method of instruction. Whatever the strategy, learning must be done by the learner. However, there are ways to facilitate the learning process by involving the student in the system that has a degree of flexibility and adaptation to individual needs. With a surge in educational communication technology, the emphasis has been on individualized instruction labelled under various titles, namely: Personalized System of Instruction (Keller), Mastery Learning (Bloom, Black), Audio-Tutorial System (Postlethwait), etc.

Voorhees College has an "open door" admission policy. Most of the student body comes from low income rural families of disadvantaged and segregated background. The freshman class is a very heterogeneous group on the basis of their interests, attitudes, reading abilities and comprehension.

We conducted a "Workshop on Course Development" during the summer of 1975. It was supported by NSF through MISIP. All the divisional faculty discussed the needs of our students. Then we carefully searched for the most effective ways to modify the learning environment and the teaching style to create an atmosphere that would enhance motivation and promote the desire to learn. We decided to try the Personalized System of Instruction (PSI). The behavioral objectives were carefully developed involving the most appropriate A-V materials for each course, planning well organized laboratory experiences, and allowing ample time for group discussions and individual tutorial sessions without sacrificing quality or quantity of the course content.

The pilot course in General Biology was taught strictly according to the "Keller Plan" i.e. self-paced, unit perfection, optional lectures only for enrichment, use of proctors for testing and immediate feedback thus promoting personal-social aspect in the educational process. The progress of the students was recorded on the class chart.

Grade distribution was discussed with the class. Also, the questionnaire gave us some clues for improvement in the mechanics of the course. The students indicated that they learned more with greater understanding than with the conventional lecture method. However, slow learners and those who are slow due to unwillingness to work found this system more demanding, and required more time to finish. This system was later extended to senior level courses. Those students who were in the pilot section worked better in higher courses offered under the PSI format. Their study habits improved and they exhibited greater responsibility in completion of assigned work. The student-teacher relationship became more friendly.

We recommend the following:

1. Develop 15 study units for a semester. Students find it convenient for steady progress.
2. Require attendance at the scheduled class times in both lecture and laboratory periods.
3. In order to qualify for an "I", students must complete at least half of the number of units (8 out of 15). Others get a grade of "F".
4. Use enthusiastic senior students as tutors who will be free at your lecture and lab time.
5. Set library hours for tutors where students can get extra help in the evening.
6. Keep "pushing" the students to read. If they don't ask questions, you ask them. Check their lecture notes for units to monitor their progress.
7. Keep the study units and unit tests up-to-date through a constant feedback from students and tutors.
8. Arrange the most appropriate and effective demonstrations, charts, slides, models,

and carefully selected A-V materials to reinforce the learning process through laboratory experience.

9. Keep up their motivation to learn. Praise their accomplishments.

With this instructional strategy, students will develop long term constructive attitudes towards independent study, self-confidence, and positive thinking.

APPLICATION OF TECHNIQUES AND TECHNOLOGY TO SOCIAL SCIENCE INSTRUCTION

Thomas Ray McAllister, Jackson State University

The state of Mississippi has the lowest level of education per individual in the United States. Yet, it is undergoing a process of urbanization which demands new knowledge and skills to facilitate the transition to a changing cultural and technological environment. The present system is faced with a serious credibility gap between natural science and social science curricula, and the present character of the society it is intended to serve. The problem of education in Mississippi reveals a necessity to address several basic needs:

1. The need to prepare young people to cope with scientific, technological, and cultural environments characterized by rapid change,
2. The need to avoid the threat of obsolescence by basing social science education upon the kind of information which will facilitate the adaptation of knowledge to new demands, and
3. The need to develop the analytical, methodological, and technical skills which can aid in adapting to a growing technological environment.

In essence, our mission is to develop scientifically literate persons with the necessary intellectual resources, values, and skills to meet the challenges of a new era. In meeting these needs, our objectives are:

1. to provide skills in the use of inferential and descriptive statistics for the analysis of social science research problems,
2. to provide skills in the use of computer technology as an aid in processing and analyzing data related to social science problem solving, and
3. to incorporate the values of inquiry methodology and an interdisciplinary approach to problem solving.

In order to meet these objectives, research classes, faculty re-tooling, and computer-assisted instruction is being conducted on the Jackson State University campus. Research classes, taught on the undergraduate level and graduate level, teach skills in statistical analysis, research design, and computer technology. These skills are applied to research report writing, focusing upon some aspect of the Mississippi Community. Faculty re-tooling workshops offer practical exercises in computer applications to social science instruction and the use of statistical packages for social science research. Computer-assisted instructional activities involve computerizing evaluation and instruction techniques which are offered to social science faculty as an aid to classroom instruction.

The attainment of these objectives will be evaluated by means of the "Product Evaluation Method" by Daniel L. Stufflebean. This project, designed to prepare Jackson State University students for careers in a highly technological society, will be evaluated by a process aimed at ascertaining the impact of knowledge of quantitative skills and techniques upon the academic achievement and career choices of our students. The factors considered in our evaluation will include: (1) grade point average and standardized test scores prior to participation in project activities, (2) grade point average and standardized test scores following project participation, (3) reports from employees, supervisors and/or graduate and professional school advisors, (4) advisory committee evaluation, (5) student evaluation, (6) consultant evaluation, and (7) project director evaluation. The purpose of the evaluation process is to determine the significance of academic achievement and the impact of such a program on career choices and performances. Preliminary indicators have shown marked success in the attainment of our objectives.

Data required in the evaluation process will be collected by the project director from the following sources: (1) participating students, (2) student records, (3) employers and advisors, (4) evaluators, and (5) internally developed questionnaires administered to each group of individuals listed.

Jackson State University, a predominately black institution of over 7,000 students, is faced with the challenge of preparing young men and women of primarily rural background, for an era characterized by a rapid influx of industry and technology. Its changing political climate is evidenced by the fact that the state of Mississippi has elected its first Republican senator in nearly 100 years. In order to meet the needs which have evolved out of these conditions, we are pursuing objectives based upon the students' knowledge and skills. This project proposes the development of analytical, technical, and methodological skills as tools to aid Jackson State University students in their incessant determination to survive and progress.

INTEGRATION AND INTERFACING OF INSTRUCTIONAL TECHNOLOGIES—THE APPLICATION OF THE PRINCIPLES OF LEARNING THEORY TO INSTRUCTIONAL DESIGN

Frederick Dumser, Jr., Community College of Baltimore

In our approach to the use of instructional technologies in science education at the Community College of Baltimore, we began from four premises: first, that technology cannot replace the interaction between two human minds; second, that technology can, with academic and fiscal integrity, be an effective extension of teachers; third, that each mode of instructional technology has its unique advantages and disadvantages and must be employed accordingly; and fourth, that evaluations of the "successful" or "unsuccessful" use of technology in education are particularly difficult to accomplish.

The Community College of Baltimore is a two-year, two campus community college serving the one million residents of Baltimore. Our students at the Liberty Campus are 77% black and 66% female. Our students evidence academic skills deficiencies such that the Science Department has defined for itself a dual responsibility—to provide the information and skills of the basic sciences while concurrently nurturing the academic and communicative skills necessary for their mastery. Such a dual role necessitates the provision of extensive contact time for students with course content and faculty. This time is provided through an audio-tutorial (A-T) instructional program administered through a Science Learning Center.

The principles and characteristics of the minicourse (A-T) program design and implementation that we have found to be of particular value are as follows:

1. *Timing and Context of Use.* Each minicourse must be carefully incorporated into a carefully organized and faculty managed course structure. Students must perceive the intent of the minicourse, its requirements, and its relationships with other course components or other minicourses (Postlethwait, Hurst, Hill).
2. *Motivation.* Students must be properly motivated to pursue the packaged information and the proper attitudes toward the learning process must be communicated to the student. Objectives must be precise and clear (Mager, Perry, Rogers, Gage).
3. *Limited Self-Pacing.* Experience on many campuses over many years has demonstrated that student self-pacing all too frequently becomes student self-neglect. Controlled self-pacing motivated by test and quiz schedules, and schedules of materials availability seem to be a reasonable compromise (Grobe, Cross, Burnett).
4. *Interaction.* Our experience and that of Postlethwait, Hurst, and others has been that student interaction with media programs is essential. Passive presentations that simply happen before the student's eyes and ears are not as productive as those in which student participation is demanded (Meyer, Ebel).
5. *Subsuming Knowledge.* We believe the concept of the advanced organizer, in the sense that this device is presented by Ausubel and others, is of value. Following this premise, information presented is related to and progressively subsumed under preexisting information within the mind of the learner (Ausubel, Ruby, Rickards).
6. *Information Transfer.* Recognizing the levels of efficiency of oral communication, written study guides are provided for each minicourse. Salient information is provided as well as charts, graphs, key terms, etc. that can be used to generate the student-program interaction referenced earlier (Gagne, Cameron, Berliner).
7. *Related Materials.* We believe minicourse effectiveness will be enhanced if alternative programs are available, both for enrichment and tutorial purposes. It has often been proven effective to simply vary the mode of presentation (Bruner, Postlethwait, Hill).

8. *Self-Evaluation and Interim Self-Testing.* Consistent with Bloom's ideas with regard to mastery learning, we believe that the student must be provided with a regular means of self-testing and evaluation as he or she moves through the various parts of a minicourse or through a particular sequence of minicourses. Presently, we are utilizing a series of computer-assisted simulations and tests for this purpose. Periodically throughout a videotape, the student will be directed to a particular terminal in the Center to complete a particular simulation of the test question set. Depending upon performance, the computer will then direct the student to return to the videotape or to take other action (Bloom, Block, Morrison, Keller).
9. *Selection of Hardware.* The technological mode of presentation for a particular minicourse (e.g. videotape, slide tape, audio tape, etc.) must be determined by content and fiscal realities.
10. *Faculty Access.* We are committed to instructional technologies as tools of and not replacements for teachers. A continual faculty presence is maintained in the Center throughout its hours of operation. Faculty offices are linked to the Center by intercom.
11. *Assume Nothing.* There is, simply put, no direction too insignificant for inclusion in the program and its guide. Students must be meticulously led from media to study guide to testing to materials and so on.
12. *Generate Success.* The adage says that nothing succeeds like success, and we believe this to be true. Accordingly, early in each minicourse, an activity is included which is easily accomplished. The intent is simply to create an attitude that says "I can do it."
13. *Staff Interaction.* Consistent with our belief that technology extends the teacher, and recognizing the benefits (both tangible and intangible) that result from faculty-student inter-action, early minicourses in a given semester are designed to force student-faculty interaction hoping to facilitate continued interaction over the course of the semester.
14. *Repetition and Pacing.* The student must clearly understand that he or she can control the pace and timing of the minicourse. The program should be designed so that the student can stop, start, and replay any or all segments as he or she chooses.
15. *Modal Conformance.* There must be a positive correlation between what is on the screen and what is being said.
16. *Environment.* The learning environment is a critical variable in generating student success. If the Center or other area of minicourse used is pleasant, attractive, and a generally desirable place to be, students will want to be there. Many of the same studies that describe the psychology of furnishing a hospital or an office apply well to learning environments and should be considered.
17. *Content Repetition.* In a given series of minicourses, each successive minicourse reviews the salient points of prior minicourses in the series. (Dumser, Cronbach).

An analysis of our results and activities to date yields the following information:

1. Minority urban students, properly motivated, will use a self-paced learning center. In the semester just completed, our forty station center and laboratory was used to capacity for 66% of its operating hours and to 87% of its capacity for 83% of its hours.
2. Students will repeat minicourses. Eighty four percent of our students repeated 55% or more of their minicourses and 95% of these students report a strong correlation between repeated access to course materials and mastery of objectives.
3. An analysis of test items on four major tests in anatomy and physiology taken by six sections of students showed that those students whose test averages placed them in the upper 30% of their class performed equally well on test items supported by tradi-

tional and minicourse instruction and students whose averages placed them in the lower 70% of their class performed better on test items supported by minicourse materials than they did on items supported by traditional presentation. Moreover, the success rates on questions supported by minicourse instruction were better than the success rates on the same questions used in the two prior years with similar groups of students.

4. Students who completed minicourses individually through the Learning Center did better upon testing than students in group sessions receiving minicourse instruction.
5. Students who completed minicourses which included integrated self-testing performed slightly better upon testing than students who did not have self-testing.
6. Retention of factual items and ideas is increased 40% or more by repetition of those facts in successive minicourses.
7. In a series of enumerated ideas, the first ideas in the series tend to be retained more consistently.
8. Ideas presented in the first 12 minutes of a program tend to be recalled more consistently than ideas presented at any other time.
9. Visual items with their identifications presented on the screen in words had more impact than the images alone.
10. Items labeled in a study guide while being identified on the TV screen were recalled more consistently than items that were presented and not labeled.
11. Sixty four percent of students surveyed found the presence of a "face" in the screen unnecessary if it was just a talking face, suggesting that an audio tape would suffice for such presentations. A reassuring, confident and dynamic presenter, however, was reported by 72% of surveyed students to "lend credibility, believability, and significance" to the information presented.

USING A VIDEOCASSETTE SYSTEM AS A PART OF AN EFFECTIVE INSTRUCTIONAL STRATEGY

Mr. Timothy Hunt, Southwestern Christian College

As part of the activities of a two-year MISIP project, the Division of Natural Sciences and Mathematics of Southwestern Christian College has been using a videocassette system in various kinds of learning situations. Southwestern Christian College is a predominantly black, private, junior college located in Terrell, Texas, and is supported by the Church of Christ. The College had a record enrollment of 369 students in the fall of 1978. During the semester, approximately 174 students were involved in science courses that used the videocassette system.

From the beginning of the MISIP project, Dr. Mary Wheeler, Director of the Instructional Television Studio at nearby East Texas State University, served as consultant. Her help in selecting the right equipment, setting up various instructional activities, and evaluating the overall project was invaluable. The equipment which was purchased under the MISIP grant included a color television camera, a videocassette recorder, four playback units, five television monitors, a lighting set, several commercially-produced videocassette presentations, and several blank videocassettes.

One of the main uses of the videocassette system has been to produce short, instructional programs that introduce students to various laboratory situations. This method has been particularly helpful in biology laboratories where close-up lenses are used on the television camera to show details in introductions to the various types of dissection. Students in several labs each week may view the videocassette. Thus, the instructor does not have to repeat the same instructions or demonstration several times in a row. The use of the close-up lenses and color in the presentations makes the videocassettes much clearer to the students than a "live" presentation by the instructor from the front of the laboratory. The instructor and laboratory assistants still have time to give personal attention to individual students. The demonstration of difficult laboratory techniques in chemistry can also be shown in this way.

Another advantage of using the videocassette system is that students may review the presentations at any time, and students who miss a laboratory can often "make-up" the work on an individual basis with a minimum of difficulty.

Commercially-produced videocassette presentations, such as those from *National Geographic* and *Encyclopedia Britannica*, can be used effectively in a classroom situation or independently by the students to bring experiences and demonstrations into the learning environment, which might be difficult to do otherwise. Two advantages of using videocassettes rather than motion picture film are that videotape does not get "scratched" as film often does and videocassette players may be easier for students to operate independently than motion picture projectors.

Some "live" broadcasts on local television stations can be reviewed by classes at times. However, copyright laws prohibit the recording of many presentations. Some news conferences and public television programs can be recorded under certain circumstances.

Student-produced videocassette presentations provide opportunities for students to be creative and to learn course material at the same time. Students can work in groups of four or five to plan, research, and then videotape a course-related project. Other side benefits gained by the students from presentations are the experience in communication skills and the overall improvement in their "self-image" as they see themselves "on television."

The use of the videocassette system at the college could be expanded to include the social sciences as well as other academic areas. Media workshops conducted for the faculty by a consultant and media courses are helpful for teachers who are involved with using the videocassette system.

Each of the methods mentioned above has been used at Southwestern Christian College during the past two years. On evaluation questionnaires many students have stated that their general interest in science courses and their overall knowledge in science have been increased through the use of the videocassette system. As part of a balanced teaching program using various media methods, lectures, assignments, and laboratory experiences, the videocassette system has been a valuable tool in improving instructional strategies.

CULTURE SENSITIVE, QUALITY SCIENCE EDUCATION AT NAVAJO COMMUNITY COLLEGE

Carl Hime, Navajo Community College

In a minority higher education institution, as is the case in others as well, students are a good source of information about your program. Likewise, they can make definite contributions to the available curriculum materials. The MISIP Project at Navajo Community College, while fully utilizing our expanded faculty and improved facility and equipment, has also taken full advantage of student and community input. The project's three prong effort is aimed at: 1) expanding course offerings in the earth/physical sciences, 2) enhancing the laboratory activities, and 3) integrating elements of the 'Navajo' experience into the development and introductory natural science courses. As these activities have been completed or are being completed, several patterns of observations have developed.

Students do not drop out of courses that they find are relevant to programs they are enrolled in or when the courses use the experiences students bring to class. For example, many of our students in the developmental classes plan to be elementary school teachers or are already working as teacher aides. We, therefore, include a good number of laboratory experiences that both illustrate the idea or concept being taught in the developmental science course, and are simple enough for the student aide to use with his or her own students. This has been especially successful in the developmental earth science course. The second idea mentioned above is that of using the experience of students as a basis for the curriculum content and strategy. A good example of this is the use of the Navajo Calendar in teaching time concepts. The Navajo Calendar is basically a lunar calendar, but the summer months tend to be amalgamated such that the several months during the summer are not always discretely conceptionalized. The winter months on the other hand, because of the privation associated with winter are counted individually. I should add, however, that some students are not aware of this and other traditional experiences, and so the instructor cannot assume analogous transfer. Another example which combines both the idea of using materials useful to the student and drawing from his experiences is the use of the Coyote Stories. They are entertaining and instructive.

Students' research projects and experiences can be used directly for instruction of other students. One example of this was a research paper prepared by a student who was a roads technician. Because of his job, he had a working knowledge of the location of various aggregates used for road work. His research paper was concerned with the locations, (maps included) of a series of dikes associated with the Sonselea Peaks area. The paper has subsequently been used as part of the discussion of volcanism. Many of the students drive by the Peaks at least once a week, and relate to the class presentation.

Students who may not have strong reading skills but are developing them, may have more than adequate learning styles. This relates back to the fact that Navajo is not, or at least until recently was not, a written language and is still not widely read. This results in the development of a learning style that is listening rather than reading oriented. This means then, that until the instructor is assured that the student's reading skills can cope with the reading materials, verbal/listening kinds of activities might be most useful for the most efficient instruction.

Student input and contributions to a course should be respected and indeed cultivated. Many times, students may approach problems from a different perspective than the instructor, but the conclusions reached may be just as useful. Likewise, the novel approach the student develops may be more easily used by other members of the class. One contribution the instructor can make is to work with the students in developing their ability to analyze the problems and solutions to assure that the students are consistent in their thinking.

The course curriculum must remain rigorous and challenging to even the best students. For some science educators, there seems to be a dichotomy between the use of the cultural experiences of students in the curriculum and a rigorous science content. Contrary to this, my experience has been that the use of students' cultural experiences is a more efficient method of teaching the more difficult and complex concepts of science. I think we would probably all agree that students will learn the facts and vocabulary of science as they progress through a series of science courses, but often the concepts involved elude students until they see some relationship between the concept and a direct experience. This does not mean, however, that the science content of the course is subjugated to the cultural world view of the student, but it does mean that the comparative and contrasting elements of the science/culture dilemma are used to strenthen the students' learning environment.

In closing, it should be pointed out that the approach we are using is producing increased enrollment in classes, reduced drops, and more students enrolling beyond the developmental level courses.

THE USE OF PROGRAMMED UNITS AND LEARNING OBJECTIVES IN AN EXPERIMENTAL PSYCHOLOGY UNDERGRADUATE CLASS

Lendell W. Braud, Texas Southern University

The psychology department of Texas Southern University (TSU) has been engaged in the development and extension of several courses which will utilize our new experimental laboratory. In the last two years we have been involved in restructuring the following courses: 1) Perception, 2) Learning, 3) Physiological Psychology, and 4) Experimental Psychology.

This paper is designed to report on our Experimental Psychology course at TSU.

The students in Experimental Psychology attend three hours of lecture and three hours and 20 minutes of lab a week. We have adopted a policy of running the lecture and lab back to back so that we can spend more time lecturing for the first half of the course and more time in laboratory activities during the last half of the course.

The lecture sections follow a traditional approach. In addition, programmed units and learning objectives are given to the students to complete at home. After teaching experimental psychology for three years, a careful analysis was made to determine the specific concepts that students found most difficult to master and programmed units were developed to cover these specific concepts.

Each programmed unit contained approximately 10-15 specific objectives to be mastered in the 8-15 page unit. The unit also contained an answer sheet so that the answer to each question or blank was included. This allowed the students to receive immediate feedback while completing the programmed unit. The purposes of these units were twofold. First, the units provided a method for easy mastery of the basic terms and definitions in Experimental Psychology. (Since all units were completed at home, this saved class time.) Second, the programmed units were specifically designed to help the student go through the reasoning processes that researchers must follow while designing and implementing a research project from start to finish. The units emphasized the thinking and reasoning process in a step by step progression.

The laboratory section included two different kinds of experimental work—demonstrations and experiments. During the first part of the semester, students participated in, and observed, demonstration projects. Students participated in tasks designed to demonstrate specific principles in memory, learning, problem solving, perception, physiological psychology, social psychology, and clinical psychology.

The experimental method is one that can be applied to any content area and it is important for students to realize that the method can be used to investigate a variety of problems. Therefore, our demonstrations included the investigation of traditional principles and lab exercises in animal learning such as bar pressing and maze running. Traditional problems in human learning, memory and problem solving were also investigated. However, we also demonstrated and investigated techniques that were more novel and intrinsically interesting such as biofeedback, and clinical problems including defensiveness, prejudice, expectancy, and extrasensory perception. There were about 10 different demonstrations provided which allowed the student some introduction into the different content areas of psychology.

The second part of the laboratory experience included independent projects. The students were given instruction in naturalistic observation and the coding of behavior. The student was given the choice of some specific behavior and specific setting such as a class, a day care center, the zoo or playground and began his or her naturalistic observation and coding of some specific behavior. Students were also given some training in correlational techniques.

The last assignment was one that lasted over half of the semester. Students formed small groups and investigated a problem in detail. They chose a project in the content area of their interest such as animal or human learning, memory, biofeedback, clinical psychology, social psychology, extrasensory perception, consciousness, etc. The students designed and ran the study. They reviewed the literature, analyzed the results and completed a report on their research.

It is important to expose the students to meaningful demonstrations and projects that are more similar to actual research than demonstrations and experiments outlined in lab manuals. Some of the studies completed and data obtained are worthy of journal publication if rewritten.

Experimental psychology is presently our only laboratory course. We have used the lab equipment for demonstrations in other course such as introductory psychology, perception, learning, and physiology. The biofeedback equipment is of particular interest to students. We also intend to add a lab to our learning course.

VIII. RESOURCE CENTER FOR SCIENCE AND ENGINEERING

The Atlanta University Resource Center for Science and Engineering.
Thomas W. Cole, Jr.

111

THE ATLANTA UNIVERSITY RESOURCE CENTER FOR SCIENCE AND ENGINEERING

Thomas W. Cole, Jr., Project Director, RCSE

I am delighted to have the opportunity to participate in this NSF sponsored Curriculum Exchange Conference, and I appreciate the invitation from Dr. Rajasekhara and the MISIP Program Staff to share with you some of our plans for the Resource Center for Science and Engineering (RCSE) at Atlanta University.

The Resource Center concept represents a new approach by the National Science Foundation in which the combined resources of the academic and local communities and the region will collectively address the problem of underrepresentation of minorities and persons from low-income families in science and engineering fields. Our approach at the Atlanta University Center (AUC) is to attack the problem through three functional components.

The Community Outreach Component is designed to heighten the awareness of career options in science and engineering fields of youth, parents, counselors, and public school teachers in the Atlanta area. The Regional Institutions Component will sponsor a series of activities aimed at enriching instruction and research for students and faculty at some 39 historically black institutions in the six southeastern states. The AUC Component is designed to strengthen instructional programs and improve research capabilities in science, mathematics, and engineering within the AUC. The AUC is comprised of Atlanta University, Clark, Morehouse, Morris Brown, and Spelman Colleges. Hopefully, the emphasis on graduate program expansion in this component will generate a mature graduate capability in the sciences and mathematics which will serve as an improved resource for the constituents to be served by the Center. The total plan was conceived during the six-month planning phase in the fall of 1977 with input from representatives from the regional institutions, consultants, students, public school officials and teachers. I now serve as the Project Director and Coordinator of the AUC Component. Working with me is Dr. Paul Brown, Assistant Director for the Regional Institutions Component, and Dr. Melvin Webb, Assistant Director for the Community Outreach Component. Three others of the AUC faculty who were instrumental in developing the proposal are Drs. Isabella Finkelstein, Louise Miller-Stevens, and Ronald Sheehy. Whatever successes we have are due in large measure to the support of our coleagues in the AUC and to the Resource Center Support Staff consisting of Ms. Claudia Huff, Communications Coordinator and Ms. Gwendolyn Sapp, Administrative Secretary.

Let us begin by describing some of the organizational complexities of the Resource Center and then move quickly to the most exciting aspect of the Center, a description of the planned activities for the next three and one-half years.

From the beginning we were quite concerned about insuring adequate representation by all constituents to be served by the Center. Our organizational scheme reflects this philosophy. A council composed of representatives from the regional science institutions serves in an advisory capacity to Dr. Brown. The council consists of: Drs. Jimmy Henderson – (Biology – Tuskegee, Alabama), Herbert Jones (Physics - FAMU, Florida), William Moorehead - (Chemistry - Ft. Valley, Georgia), Walter Patillo – (Biology – NC Central, North Carolina), J. Henry Sayles – (Chemistry – Bennett, North Carolina), Ragbir Singh – (Biology – Benedict, South Carolina), and James Perkins – (Chemistry – Jackson State, Mississippi).

Dr. Melvin Webb is advised by a committee composed of reprentatives from the Atlanta Public Schools, City of Atlanta, PTA Organizations, and representatives from the lay community.

In an advisory capacity to the Project Director for total program monitoring are three committees:

1. Atlanta University Science Committee of Academic Programs (AUSCAP) is composed of Science Representatives from each of the AUC Institutions and Department

Chairs of Chemistry, Biology, Physics, Mathematics, and program directors from the Dual Degree Program.
AUSCAP in concerned with in-center relationships, program development, and evaluation, particularly at the graduate level.

2. Institutional representatives to AUSCAP comprise a self-contained committee, the Executive Committee to RCSE, which serves in an advisory capacity to the project director for policy and program review at the implementational level.
3. A third committee, the Liaison Committee for Overall Program Review, consists of academic deans of AUC colleges, representatives from Georgia Institute of Technology, The University of Georgia, Atlanta Public Schools, and Dr. Joseph Gayles, President of Talladega College, who represents the Regional Institutions. The existence of so many committees may at first glance appear unweildy, but they are necessary to insure continuous involvement of all constituents affected by the Resource Center.

One of the most exciting activities of the recently initiated community component of the Resource Center is the Saturday Science Academy. Presently, 103 students from grades three through eight, three faculty members, and six student assistants from the AUC institutions are meeting on Saturdays at John F. Kennedy Middle School and Community Center in Atlanta. The program consists of an instructional component from 9:00 A.M. — 12:00 Noon devoted to discovery learning mathematics, hands-on laboratory work in science, and creative writing in science. The students are served lunch and participate in organized recreational activities for two hours in the afternoon. We were most gratified when the opening session on a cold and rainy day in Atlanta brought 103 of the 110 applicants selected and over 50 parents, many of whom remained throughout the day to talk to Resource Center staff and faculty, and to observe the classroom instructional program. Some of the special activities planned for the participants include exposure to computer graphics (Apple II System), field trips to Fernbank Science Center, outdoor learning center and a Boeing 747 airplane—made available to us free of charge. The initial response to the Saturday Science Academy has been overwhelmingly positive with such comments heard over lunch from the students such as "that math teacher is crazy," and "I enjoyed the science class better," or "I don't mind missing cartoons today—I hope every Saturday will be like this." We hope, too, that each Saturday will be so exciting. We plan to tape sessions of the Academy as a pilot for a 20-minute film production. Next year we hope to involve some 200-300 elementary school children in a city-wide selection process. This year, we limited involvemment to students from the immediate vicinity of the AUC, where a large number of students from low-income families are located. We believe that the age group of students in the Academy represents a critical stage in developing attitudes toward science and scientific careers. Some schools do not introduce science subjects until the 7th or 8th grade, and by then many children are already turned off to science as a career. We think the Saturday Science Academy will have a significant impact on the career aspirations and interests of these elementary school children. In addition to the Academy, other activities are planned for the community component.

A Summer Institute in Science and Mathematics will be conducted for junior and senior high school students, in which approximately 50 high school youth will be involved. The Institute will run for eight weeks and all participants will reside on campus. Room, board, and materials will be provided, along with a modest stipend. Coursework will center around interdisciplinary science, laboratory work, mathematics, computer technology and programming. Special Institute activities will include several field trips and presentations by guest speakers.

The Resource Center will sponsor an Annual Workshop for High School Counselors aimed at updating their awareness of career trends and options in science. Minority and low-income students are heavily dependent upon counselors for career guidance. Counselors often steer capable students away from careers in science in much the same way as females have traditionally been advised against these options. Video-tape and hard-copy recruitment materials will be developed for the various science disciplines and made available to counselors and to the regional institutions.

Beginning in the fall, the Resource Center will offer four Increment-Credit Courses on science instruction in grades K-3, 4-6, 7-9, and 8-12. Materials developed by the instructional offices of the local public school systems and other agencies will provide the initial basis for these courses, which can be used to meet continuing certification requirements for teachers.

An Open House is scheduled for each spring in which students, parents, teachers, counselors, and other interested persons will be invited to view student-initiated science projects, participate in demonstrations, and tour science facilities. Selected high school juniors and seniors will be invited to visit the AUC institutions to join freshmen science majors in a typical schedule of classes, laboratories, and seminars. In addition, opportunities for talented high school youth to participate in Joint Enrollment Programs between the AUC and their high schools will be expanded.

The Regional Institutions Component will sponsor a series of activities aimed at enhancing instruction and research in 39 historically black institutions in the Southeast. As additional funds become available, more colleges will be involved. A series of short courses, providing experimental and theoretical experiences, will be offered to regional institutions faculty on an annual basis. Topics include spectroscopy, mathematical modeling, application of minicomputers, computer-instrument interfacing, and selected subjects in biochemistry and molecular biology.

An eight-week Summer Enrichment Program will be conducted annually for thirty students from colleges in the region. This program will offer senior-level coursework in areas not available at the home institution, such as molecular biology, linear algebra, atomic and molecular structure, physical chemistry, and advanced organic chemistry. Small seminar and individual tutorial courses will be offered as needed.

Another element of this component will provide institutional program review and proposal development assistance through Consulting Scientists. These scientists, drawn from the AUC and other sources will visit institutions upon request to provide counsel, advice, and information on strenthening science capabilities.

In an effort to expand research opportunities at the regional institutions, the Resource Center will enhance the availability of research resources in the AUC to faculty and students from the region. Funding of this thrust will include travel expenses, computer costs and support for shop services and equipment modifications.

The third component of the Resource Center (AUC Component) will significantly improve the instructional programs and research capabilities in the science areas in the AUC. Expansion is projected for several academic areas including biology, chemistry, mathemaitcs, computer science, and physics. An undergraduate engineering laboratory will be added to strengthen the Dual-Degree Program, a cooperative program involving the Georgia Institute of Technology and the AUC Institutions. Resources will be focused to achieve strong research activities in a number of areas including biochemistry, molecular biology, and microbiology. Plans call for appointing new faculty members (11) and hiring adjunct faculty, as well as doctoral and post-doctoral research associates. New degree programs to be added include an M.S. degree in physics, Ph.D. degree in chemistry, and an M.S. emphasis in Computer Science.

Finally, the Resource Center will sponsor two conferences on Issues in Minority Science Education. The first such conference is scheduled for this year and will focus on identification of priority issues and needs in this area.

We are still quite excited about this new venture in the Atlanta University Center. By any conservative estimate, it would take more than three to four times the $2.76 million awarded to adequately address the important problem (that brings us together at this meeting in Washington) of increasing the representation of minorities and students from low-income families in science and engineering fields. We are confident that we can achieve our objective in a fashion so typical of historically black institutions in the United States of doing a lot with a relatively small amount of money. We invite your continued support and encouragement so that our success with the Resource Center in Atlanta and that of the second Center to be awarded this year will send back a message to Congress to appropriate funds for more Centers in subsequent years.

In closing, let me say, there has been a lot of hard work by a lot of people and there were times when I wish I were in my laboratory and teaching students instead. Fortunately, these feelings are short-lived when one recognizes the enormous impact the Resource Center will have on the future careers of so many young people. It is an exciting challenge and I wish to express my personal appreciation to a my colleagues in the AUC who worked so hard to generate a successful proposal through three review stages, to Dr. William Jackson of Howard University who articulated the Resource Center concept before Congress, Dr. Jose Martinez and scientists from the minority community who supported and assisted in the conceptualization of the Resource Center idea, Senator Kennedy and the U.S. Congress for appropriating the money to initiate two Centers, and to the National Science Foundation for their confidence in placing the first Resource Center at Atlanta University in the Atlanta University Center.

IX. MINORITY-FOCUSED PROGRAMS IN FEDERAL AGENCIES

Water Research and Technology.
William H. McCoy

Minority Access to Research Careers.
Elward Bynum

Employment Programs at National Bureau of Standards.
Ana Jankowski

The Minority Biomedical Support Program.
Ciriaco Q. Gonzales

Office of Naval Research.
Robert Hayles

Minority Education Programs.
James Kellett

Research at Universities with Predominant or Significant Minority Enrollment
Jurgen Pohly

Minority Institutions Research Support Program.
Walter Preston

Minority College Opportunities in the Department of Transportation.
William Brown

U.S. Geological Survey's MPES Program.
J.V. O'Conner

Minority-Focused Programs at the National Science Foundation.
Paul H. Rodriguez

WATER RESEARCH AND TECHNOLOGY

William H. McCoy, Water Research Scientist Office of Water Research and Technology
United States Department of the Interior, Washington, D.C. 20240

The Office of Water Research and Technology (OWRT) has the Congressionally authorized mission both to identify critical problems in water resources and to engage in contractual research to solve them. The following activities constitute the overall program: 1) allotments to water resources research institutes, in each State and territory (total 54 - about 6 million dollars per year), 2) matching grants submitted through institutes, bearing on water resources problems in general (about 5 million dollars per year), 3) focused grants not requiring matching funds, submitted with respect to: a) saline water conversion research (about 2 million dollars per year), b) water reuse (about 1.3 million dollars per year), c) other significant areas like urbanization and conservation (about 1.5 million dollars per year), 4) technology development, primarily saline water conversion development (about 8 million dollars per year), 5) technology transfer, intended to transfer results of research to the using public (about 2 million dollars per year), and 6) administration.

There is no formal, legally authorized means whereby we can set aside any special allocation for minority groups. We now have a few contracts with organizations primarily concerned with minority group procurement. In one instance, the thrust is toward basic education; in another, a handbook will be prepared specifically designed to assist minorities in proposing water resources research and technology to the government.

I am very pleased to be project officer for these contracts, and assure this audience that we in OWRT will be completely fair and objective in evaluating research proposals and will do our best to utilize one of this nation's least recognized and badly needed resources: minority firms and persons having ability and interests potentially leading to good research in water resources problems.

MINORITY ACCESS TO RESEARCH CAREERS

Elward Bynum, Director, MARC Program
National Institute of General Medical Sciences
National Institute of Health, Bethesda, Maryland 20014

The Minority Access to Research Careers (MARC) Program was made a formal program of the National Institute of General Medical Sciences in January, 1976. The MARC Program was designed to assist minority institutions in the training of greater numbers of scientists and teachers in health related fields. The ultimate objective of the program is to strengthen the teaching and research capabilities of these institutions.

The mechanisms for implementation are the following: the Visiting Scientist, the Faculty Fellowship, and the MARC Honors Undergraduate Research Training Programs.

EMPLOYMENT PROGRAMS AT NATIONAL BUREAU OF STANDARDS

Ana Jankowski, Coordinator Equal Opportunity Programs, Washington, D.C. 20234

The National Bureau of Standards (NBS) is a unique research laboratory of the Federal Government. Founded in 1901, NBS has become one of the Nation's largest physical and computer science laboratories with a worldwide reputation for scientific excellence and reliability.

The Bureau's work is challenging in its diversity. Both fundamental and applied research are conducted on its two campuses. Besides providing the basic standards of physical measurement for science, industry, and the Government, NBS conducts research in fields ranging from nuclear physics to building technology. The Bureau applies its scientific competence to help solve serious national problems with technical elements. Some of these problems are in pollution control, the search for new energy and conservation of existing supplies, semi-conductor technology, electromagnetic radiation, fire control, materials research, and automation.

To meet its responsibilities, the Bureau employs an interdisciplinary staff of approximately 3,600 persons. Approximately 41% of the Bureau's professional staff have Ph.D. degrees, 22% have master's degrees, and 33% have bachelor's degrees.

The following describes some of the Bureau's employment programs.[1]

COOPERATIVE EDUCATION

The Bureau employs college students at the graduate and undergraduate levels in a program that alternates semesters of academic study with periods of full-time employment at NBS. (Some students attending two-year institutions may work part-time while attending school.) Universities participating in the program refer applications to NBS for selection. Students completing the full-time program are eligible for non-competitive conversion to permanent positions (GS-2 through GS-9).

GRADUATE RESEARCH FELLOWSHIP PROGRAM

An educational program designed to increase the number of post-graduate degrees in fields of special interest to NBS is provided for NBS employees. The program supports full-time education plus salary. Newly hired employees are eligible participants (GS-5 through GS-9 plus payment of educational expenses).

QUALITY STAFFING

The Bureau hires outstanding college graduates interviewed during on-campus college recruiting visits or identified through other NBS recruitment sources (GS-7 through GS-11).

FACULTY INTERN

College faculty members are employed for varying periods of time to fill gaps created by summer vacations, and occasionally for longer periods (GS-9 through GS-12).

NATIONAL RESEARCH COUNCIL POSTDOCTORAL RESEARCH ASSOCIATESHIP

The National Research Council (NRC) Research Associateship Programs provide opportunities for basic and applied research to postdoctoral and senior postdoctoral scientists and engineers of unusual ability and promise. Appointments are awarded on a competitive basis by NRC. Stipends are $17,000 and upwards for Regular Research Associates with higher stipends for seniors. (Seniors must have held the doctorate for five years.)

---

[1] NBS is an affirmative action/equal opportunity employer.

ADMINISTRATION INTERN

Graduates in administrative majors are selected from the civil service register (PACE) for employment in administrative areas of NBS (GS-5 through GS-9).

ACADEMIC SUMMER PROGRAM

Undergraduate and graduate students are employed during the summer months to complete short-term projects, fill employment gaps created by summer vacation schedules, and provide a source for recruiting future NBS staff members (GS-2 through GS-9)

Technical disciplines in which we are particularly interested are: computer science, electrical and electronic engineering, mechanical engineering, physics, and chemistry.

THE MINORITY BIOMEDICAL SUPPORT PROGRAM

Ciriaco Q. Gonzales, Director, Minority Biomedical Support Program
National Institutes of Health, Bethesda, Maryland 20014

INTRODUCTION

Mission

Because of the dearth of minority scientists available to participate in the activities of NIH, there is a consequential need to develop and implement ways of increasing the number and quality of minority persons engaged in health-sciences research.

Objectives

The Minority Biomedical Support (MBS) Program strives to provide ways and means of increasing the number and potentiating the level of expertise among American Indian or Alaskan Native, Asian or Pacific Islander, Black, and Hispanic health scientists. The Program also endeavors to strengthen the capability of minority institutions to provide health research career opportunities to their students and to conduct research in the health sciences. The goals are meant to be achieved by motivating and training students to pursue research careers by having them participate in research while enrolled as undergraduates, by supporting graduate and postdoctoral students in health-science research, and by the support of faculty at eligible institutions in order to assist them in developing and broadening their biomedical research capability. The proficiency development of the minority institution is achieved through support for equipment, renovations and alterations, animal facilities, research management, and the increase and improvement of faculty and curriculum.

MBS BUDGET HISTORY

YEAR	BUDGET (DOLLARS)
1972	2 million
1973	5 million
1974	8 million
1975	7.2 million
1976	7.6 million
1977	9.7 million
1978	10.7 million
1979	14.7 million
1980	14.3 million

AUTHORIZATION FOR THE PROGRAM

The Minority Biomedical Support Program was initiated in Fiscal Year 1972 under the General Research Support authority contained in section 301(c) of the Public Health Service Act (42 U.S.C. 241(C)), utilizing funds earmarked for the Program in the Departments of Labor and Health, Education, and Welfare and Related Agencies Appropriation Act, 1972 (Pub. L. 92-80).

PROGRAM PARTICIPATION

The present program supports 70 grants in 76 institutions involving 469 research projects. Within the separate research projects, there are involved 1,097 undergraduates, 207 graduate students, 4 postdoctoral participants, and 598 faculty for a total of 1,906 participants.

MINORITY BIOMEDICAL SUPPORT PROGRAM
NUMBER OF PARTICIPANTS

						Students by Ethnic Group				
Year	Faculty	Other Staff	Undergrads	Predoc.	Postdoc.	Black	Hispanic	N.A.*	Islander	Other
1972	199	N/A	282	45		362	52	10	3	—
1973	258	N/A	962	83	0	669	136	24	16	26
1974	485	72	881	144	3	1,157	342	44	48	87
1975	475	78	864	152	5	1,088	381	47	62	72
1976	599	123	1,101	207	4	1,237	446	58	33	81
1977**	452	120	928	179	16	229	32	16	9	12

*Native American

**Data is incomplete for 1977

OFFICE OF NAVAL RESEARCH

Robert Hayles, Assistant Director
Organizational Effectiveness Research Program
Arlington, VA 22217

The Office of Naval Research (ONR) has all of the programs and activities aimed at affirmative action in hiring, training, promoting, firing, etc. which most agencies possess. It does not have a special program designed to increase minority participation in its contract research program. Such participation is encouraged by indiviuals such as myself who are employed by ONR. I serve as an unofficial point of contact for persons and organizations seeking support for research from the Navy as well as the other services. ONR sponsors long-range scientific research believed to offer potential for advancement and improvement of naval operations. Research funded by ONR is conducted in part under contract by universities, nonprofit institutions, industrial establishments; and in part by Navy laboratories. Two major types of programs are supported by ONR. First, fundamental knowledge that leads to solutions of Navy problems is acquired through support of long-range research.Contracts are generally awarded in reponse to unsolicited proposals. Second, a program of applied research and exploratory development is conducted to develop naval technologies and to study and test concepts in naval operational systems. The major scientific and technology divisions in ONR are: naval vehicles and weapons technology, sensor and control technology, analysis and support sciences, mathematical and information sciences, biological sciences, psychological sciences, arctic and earth sciences, material sciences, and ocean science and technology. Additional information about ONR or research support available from the other services can be obtained through: Dr. Robert Hayles, Office of Naval Research, 800 N. Quincy Street, Arlington, Virginia 22217. I strongly encourage you to see how such support can contribute to the quality of education in minority institutions.

MINORITY EDUCATION PROGRAMS

James Kellett, Director
Education Programs Division, Department of Energy
Washington, D.C. 20545

The Department of Energy takes very seriously its commitment to affirmative action in its hiring actions. Our Office of Equal Opportunity offers a variety of services as well as guidance to both Department of Energy (DOE) employees and to prospective employees; that Office is headed up by Mr. Marion Bowden, whose telephone number is (202) 376-4624. Mr. Bowden is also our liaison person for the Department's implementation of the Presidential directive of January 17, 1979 which deals with Federal outlays to predominantly Black institutions.

Of particular interest to this audience are the steps that the Department is taking to realize its larger affirmative action goals affecting minorities in the science and engineering careers that contribute to our achievement of the objectives of the National Energy Plan. One program, the Pre-Freshman and Cooperative Education Program, with the acronym PREFACE, encourages qualified and qualifiable high school students to pursue engineering careers. This effort is aimed at improving accessibility of engineering as a career since engineering is a profession which is now and will continue to be critical in the development of energy resources and in the conservation of energy; it is also a field generally underrepresented by minorities. In FY 1979, the Department will support twenty engineering schools with approximately $300,000. The contact for this program is Dr. Ruth Ann Verell, whose number is (202) 252-6480.

The Department's Office of Energy Research also seeks out predominantly Black institutions for support to improve their ability to conduct energy related research. In FY 1978, eight institutions received approximately $600,000 for this purpose. A contact for this program is Mr. Richard Stephens, whose telephone number is (202) 376-9387.

RESEARCH AT UNIVERSITIES WITH PREDOMINANT OR SIGNIFICANT MINORITY ENROLLMENT

Jurgen Pohly, University Affairs Office
National Aeronautics and Space Administration
Washington, D.C. 20546

The purpose of the program is to assure that resources of all elements of the higher education community are effectively brought to bear on aeronautics and space problems.

The objectives of the program are:

1. To conduct high-quality, innovative university research on high priority problems of long term interest to NASA.
2. To complement and support NASA's ongoing research.
3. To strengthen the education and research capabilities of universities through the conduct of research.
4. To attract the nation's best talent into space-related science and engineering.

Summer Faculty Fellowships

For U.S. citizens who are faculty or research members of minority institutions, especially screened for professional potential there are summer faculty fellowships. These fellowships are awarded for 10 weeks during the summer, and are renewable during the second summer. Stipends are $400 per week and travel allowance paid. About 20 fellowships are awarded each year in research. Programs are operated by co-directors from centers and collaborating universities.

Goddard Space Flight Center–Morgan State University
Langley Research Center–Hampton Institute

Resident Research Associateships

Postdoctral and senior postdoctoral associateships are available at NASA centers. About 231 associateships are awarded each year. Associateships are usually awarded for one year, renewable for a second year. The program is administered by the National Research Council-National Academy of Sciences-National Academy of Engineering.

MINORITY INSTITUTIONS RESEARCH SUPPORT PROGRAM

Walter Preston, Assistant Director
U.S. Environmental Protection Agency
Washington, D.C. 20460

Since 1972, the Office of Research and Development (OR&D) has operated the Minority Institutions Research Support Program (MIRS). This Program was established as a special effort by OR&D and the Agency to assist these institutions in the development of their existing and potential capabilities for conducting environmental research. The ultimate goal is to help these institutions to become more competitive for Federal research funds.

During the six years of MIRS operation, a total of 5.4 million dollars have been obligated to minority institutions. About 32% or 1.7 million was contributed by OR&D laboratories by a cost sharing formula by which the grants are initiated with MIRS funds and receive increasing laboratory funds in the second and third years. A total of 45 separate institutions have received 105 grant awards with 22 of those still in active status. These awards have provided financial assistance and research opportunity for 75 professors and 145 students.

In fiscal years 1980 and 1981, the MIRS budget will increase by 250 thousand dollars each year the MIRS staff is making plans to expand the support to include non-minority colleges and universities which have a high enrollment of minority students (for example, California State, Los Angeles). Finally, we are making plans to establish a graduate research participation program with selected minority institutions. In this program, graduate students from these institutions will be able to conduct their thesis or dissertation research at an appropriate OR&D laboratory by mutual agreement between the student, the institution, and the OR&D laboratory.

MINORITY COLLEGE OPPORTUNITIES IN THE DEPARTMENT OF TRANSPORTATION

William Brown, U.S. Department of Transportation
Office of University Research
Washington, D.C. 20590

The Department of Transportation (DOT) is responsible for the development of national transportation policy and programs conducive to the provision of fast, safe, efficient, and convenient transportation at the lowest cost consistent with other national objectives. DOT is composed of eight major agencies. These agencies offer various forms of the following types of programs:

(a) Management Intern
(b) Cooperative Education—Graduate, Undergraduate
(c) IPA Faculty Fellow
(d) Fellowship
(e) Minority Employment
(f) Summer Work—Faculty, Student
(g) Training
(h) University Research

The nine DOT agencies and their general functions are:

The Office of the Secretary of Transportation (OST) includes staff units responsible for issues that crosscut various modes of transportation.

The Federal Aviation Administration (FAA) is responsible for promoting and regulating aviation safety.

The Federal Highway Administration (FHWA) improves highway transportation systems and their operation in cooperation with the States, and grants financial aid to States for highway construction and safety improvements.

The Federal Railroad Administration (FRA) promotes rail safety, establishes safety standards for rail operations, conducts research into rail safety and improved technology and operations, and investigates train accidents.

The National Highway Traffic Safety Administration (NHTSA) is charged with reducing deaths, injuries, and property losses by highway accidents in the United States.

The Research and Special Programs Administration (RSPA) develops and manages research and development programs in all fields of transportation, and also is responsible for the safe transportation of hazardous materials and for pipeline safety.

The Saint Lawrence Seaway Development Corporation (SLSDC) is a self-sustaining government corporation authorized by Congress to construct, operate, maintain, and develop the St. Lawrence Seaway jointly with the St. Lawrence Seaway Authority of Canada.

The United States Coast Guard (USCG) is charged with primary responsibilities for maritime safety and law enforcement, as well as facilitating transportation by water.

The Urban Mass Transportation Administration (UMTA) administers grant programs to improve transit service, including grants to aid States and other public bodies in financing mass transit facilities, operations, and equipment in urban areas.

As mentioned at the Conference, the best way to get started in any of the programs at DOT is to explain your interests in a telephone call. The Minority Affairs Coordinator for the Research and Special Programs Administration is Wilbur Williams. He can be reached at (202) 426-0190 and will be happy to place you in contact with the proper program personnel in the Department of Transportation.

U.S. GEOLOGICAL SURVEY'S MPES PROGRAM

J.V. O'Conner, National Coordinator
USGS MPES Program
University of Virginia, Reston, VA 22092

On September 21, 1971, the U.S. Geological Survey committed its resources to an outstanding volunteer internal program directed toward increased participation by minority groups in the Earth Science professions.

As the single largest employer of earth scientists in the U.S., the U.S.G.S. established a system of working groups under the title Minority Participation in Earth Science (MPES) program which operates within the Survey and with the cooperation of other Federal agencies, civil, community, education and professional organizations, and with industry to develop a flow of talented young people from all racial, ethnic, and economic backgrounds into geology, geophysics, mineral engineering, hydrology, cartography, and related sciences.

The MPES program is based on the establishment at each Survey center or field office of a working group that assesses regional minority problems and develops a plan of action for dealing with these problems.

Four major areas are stressed under the MPES program. They are:

1. Summer or academic year employment of minority high school seniors and undergraduate college science students.
2. Thesis support and scientific work experience for minority graduate students,
3. Strengthening or establishing undergraduate earth science programs in predominantly minority colleges and universities, and
4. Stimulating interest in earth science careers among minority students at the pre-college level via exhibits, workshops, conference, and publications.

The cost of the program is underwritten by the Director's Office of the U.S.G.S. Materials on past achievements and the future are available on request.

For more information contact J.V. O'Connor, (703) 860-6384 or a local Survey office.

MINORITY-FOCUSED PROGRAMS AT THE NATIONAL SCIENCE FOUNDATION

Paul H. Rodriguez, Program Manager

The National Science Foundation has several programs that are designed to increase minority participation in science and engineering. These include the following: 1) Research Initiation in Minority Institutions (RIMI), 2) Minority Institutions Science Improvement Program (MISIP), 3) Resource Centers for Science and Engineering (RCSE), 4) Minority Graduate Fellowships (MGF), 5) Minority Institutions Graduate Traineeship (MIGT), and 6) Minorities in Science (MIS).

RIMI supports basic science research by faculty members of those institutions of higher education whose enrollments are predominantly (more than 50%) composed of Black, Native-American, Spanish-Speaking, or other ethnic minorities.

MISIP is designed to effect long-range improvements in science education at minority institutions. Support is provided for activities designed to enhance an institution's capacity for developing and maintaining a quality science education program and for increasing the flow of underrepresented ethnic minorities into scientific careers.

Established in FY 1978, RCSE is designed to promote increased participation in science and engineering by minorities and persons from low-income families. Resource Centers established through the Program are expected to accomplish this goal by serving as regional resources for nearby minority or low-income communities as well as by developing joint educational programs with regional pre-college and undergraduate institutions enrolling a substantial number of minority or low-income students.

The objective of the Minority Graduate Fellowship Program is to increase the number of practicing scientists who are members of ethnic minority groups which traditionally have been underrepresented in the advanced levels of the Nation's science talent pool. Fellowships are awarded for study or work leading to master's or doctoral degrees.

MIGT is designed to improve access to careers in science and technology by graduate students attending predominantly minority universities which offer the master's or higher degrees in the sciences.

The objectives of the Minorities in Science Program are to identify, attract, encourage, motivate and help prepare minorities in scientific careers. Currently, these objectives are being accomplished through two established student-oriented programs which are designed to enhance the preparation of high school (Student Science Training, SST) and undergraduate (Undergraduate Research Participation, URP) minority students at a critical point in their career development. SST supports the active participation of high school students with college faculty in specially designed instruction and investigative work; URP provides support for undergraduates to work directly with science faculty or industrial scientists on research projects.

For additional information about any of the minority-focused programs, write to: National Science Foundation, Washington, D.C. 20550

X. CONFERENCE PROGRAM

130

MINORITY INSTITUTIONS CURRICULUM EXCHANGE CONFERENCE

PROGRAM

January 19-20, 1979
Washington Hilton Hotel
Washington, D.C.

The Conference is supported by the National Science Foundation under contract (#SER-78-25812) to Barber-Scotia College, Concord, North Carolina

ADVISORY COMMITTEE

Coordinator: **KOOSAPPA RAJASEKHARA**
Professor of Biology
Barber-Scotia College
Concord, North Carolina

Members: **DON AHSHAPANEK**
Instructor of Biological Sciences
Haskell Indian Junior College
Lawrence, Kansas

JOSEPH McPHEE
Assistant Professor of Natural and Applied Science
CUNY LaGuardia Community College
New York, New York

SIGFREDO MAESTAS
Professor of Chemistry and Dean of Academic Affairs
New Mexico Highlands University
Las Vegas, New Mexico

JAMES PERKINS
Professor and Head, Department of Chemistry
Jackson State University
Jackson, Mississippi

NELLOUISE WATKINS
Associate Professor of Mathematics and Director, Computer Center
Bennett College
Greensboro, North Carolina

SUPPORT STAFF

KAY CRESS, MARTHA PORCHER
Barber-Scotia College
Concord, North Carolina

MINORITY INSTITUTIONS
CURRICULUM EXCHANGE CONFERENCE

January 19-20, 1979
Washington Hilton Hotel
Washington, D.C.

The goals of the Conference are to facilitate contact and exchange of information among natural and social science faculty representatives at minority institutions, concerning advances in curriculum development and instructional techniques which may enhance the quality and effectiveness of science education at these institutions; and to increase interest in the continued improvement of science education at minority institutions.

An expected outcome is that the institutions participating in the Conference will continue to share or exchange science related information and materials after the Conference. The proceedings of the Conference will be published and disseminated in the Spring of 1979.

MEETING INFORMATION

Registration	Concourse
Information and Message Center 8:00 a.m. - 5:00 p.m.	Concourse
Message Board	Concourse
Conference Headquarters	Coordinator's Suite
Curriculum Materials and Other Displays	Jefferson Room

Open 9:00 a.m. - 8:00 p.m. on Friday, and
9:00 a.m. - 5:00 p.m. on Saturday

Coffee Break Area	Jefferson Room

MINORITY INSTITUTIONS
CURRICULUM EXCHANGE CONFERENCE

PROGRAM

FRIDAY, JANUARY 19

Concourse 8:00 a.m. - 9:00 a.m. REGISTRATION

TIME PERIOD 1 **GENERAL SESSION**
International Ballroom East **9:00 a.m. - 10:15 a.m.**

Presiding: KOOSAPPA RAJASEKHARA, Coordinator, Curriculum Exchange Conference

Welcome: MABLE P. McLEAN, President, Barber-Scotia College

Rationale of the Conference: SHIRLEY McBAY, Program Director, Minority Institutions Science Improvement Program, National Science Foundation

Introduction of The Keynote Speaker: ROBERT HARVEY, Program Manager, Graduate and Post Doctoral Programs, National Science Foundation

Keynote Address

JOSEPH N. GAYLES, JR., President, Talladega College

Future Role of Science at Minority Institutions

Jefferson Room 10:15 a.m. - 10:45 a.m. COFFEE BREAK

TIME PERIOD 2 INSTRUCTIONAL STRATEGIES IN THE NATURAL AND SOCIAL SCIENCES
FOUR CONCURRENT SESSIONS 10:45 a.m. - 12:00 noon

Session I - Natural Sciences
Georgetown Room East

Moderator: SIGFREDO MAESTAS, New Mexico Highlands University

Participants: JOYCE CORRINGTON, Xavier University

Employing Behavioral Objectives and Drill to Improve Student Comprehension and Retention in Organic Chemistry at Xavier University

MARCELINA VELEZ DE SANTIAGO, Catholic University of Puerto Rico

Modular System of Instruction for General Chemistry

Session II - Natural Sciences
Georgetown Room West

Moderator: DON AHSHAPANEK, Haskell Indian Junior College

Participants: MARY RYAN, Xavier University

Multi-Pathways to Learning General Chemistry: PSI Lecture with Piaget-Based Laboratories

GEORGE MISKIMEN, University of Puerto Rico, Mayaguez

Instructional Strategies in Biological Sciences-Videotape Presentation of Basic Biological Concepts

Session III - Social Sciences
Monroe Room East

Moderator: MARGARET VASQUEZ, New Mexico Highlands University

Participants: FRANK BRIMELOW, Voorhees College

Individualizing Courses in the Social Sciences: The Blending of A/V Modules and Personalized Self-Paced Instruction

ALICE KIDDER, North Carolina A&T State University

Teaching Innovations in Applied Economics

Session IV - Social Sciences
Monroe Room West

Moderator: LESLIE McLEMORE, Jackson State University

Participants: HELEN BARRETT, Tennessee State University

Modernizing Instructional Capabilities in General Experimental Psychology at Tennessee State University

EDWARD POWELL, Texas Southern University

Planning the Behavioral-Sciences Laboratory at Texas Southern University

12:00 noon - 1:30 p.m. LUNCH BREAK

TIME PERIOD 3 COMPUTER-ASSISTED INSTRUCTION
THREE CONCURRENT SESSIONS 1:30 p.m. - 2:15 p.m.

Session I
Georgetown Room East

Moderator: NELLOUISE WATKINS, Bennett College

Participants: JAMES BECK, Virginia State College

Using the Computer in the Teaching of Science

CARL POLOWCZYK, Bronx Community College

Increasing Success in and Undertaking of Science among Urban Minority Students [Project ISUS]

Session II
Georgetown Room West

Moderator: JOSEPH McPHEE, LaGuardia Community College

Participants: ALEX BONILLA, University of Puerto Rico, Rio Piedras Campus

Computer-Assisted Instruction in General Chemistry

JOHN GARNER, Tougaloo College

Scientific Academic Computer Planning Process

Session III
Monroe Room East

Moderator: JOHN HALL, Morehouse College

Participants: JESSE LEWIS, Jackson State University

Innovative Instructional Uses of Computers at Jackson State University

AMADOR MURIEL, Burlington County College

Interactive Computer-Assisted Drills and Exercises in Science Courses at Hostos Community College

TIME PERIOD 4 GENERAL SESSION
International Ballroom East 2:15 p.m. - 3:00 p.m.

PANEL DISCUSSION ON TECHNICAL SYSTEMS FOR ACADEMIC COMPUTING

Presiding: NELLOUISE WATKINS, Bennett College

Panelists: MANUEL GOMEZ RODRIGUEZ, University of Puerto Rico, Rio Piedras Campus

JOHN HALL, Morehouse College

JESSE LEWIS, Jackson State University

Jefferson Room 3:00 p.m. - 3:30 p.m. COFFEE BREAK

TIME PERIOD 5 GENERAL SESSION
International Ballroom East 3:30 p.m. - 5:00 p.m.

MINORITY-FOCUSED PROGRAMS IN FEDERAL AGENCIES

Introductory Remarks: SHIRLEY MALCOM, Program Manager
Minority Institutions Science Improvement Program
National Science Foundation

Presiding: EDWARD BRANTLEY, Director, Division of Institutional Development Programs, Office of Education

Panelists: JAMES BURTON, Assistant Director of Research, Office of Water Research and Technology, Department of Interior

ELWARD BYNUM, Director, Minority Access to Research Careers Program, General Medical Sciences, National Institutes of Health

THOMAS DILLON, Deputy Director, National Bureau of Standards

THEODORE GLEITER, Assistant Administrator for Administration, National Oceanic and Atmospheric Administration

CIRIACO GONZALES, Chief, Minority Biomedical Support Program, Division of Research Resources, National Institutes of Health

ROBERT HAYLES, Assistant Director of the Organizational Effectiveness Research Programs Office of Naval Research

JAMES KELLETT, Director, Education Programs Division, Department of Energy

JAMES LAWSON, Director, University Affairs Office, National Aeronautics and Space Administration

WALTER PRESTON, Assistant Director, Minority Institutions Research Support, U.S. Environmental Protection Agency

ROBERT RIVERA, Director, Office of University Research, U.S. Department of Transportation

PAUL RODRIGUEZ, Program Manager, Minority Institutions Science Improvement Program, National Science Foundation

Jefferson Room 5:00 p.m. - 6:00 p.m. SOCIAL HOUR

SATURDAY, JANUARY 20

TIME PERIOD 6 GENERAL SESSION
International Ballroom East 9:00 a.m. - 10:00 a.m.

Presiding: SIGFREDO MAESTAS, Dean of Academic Affairs, New Mexico Highlands University

Presenter: THOMAS COLE, Project Director, Atlanta University

Description of the Atlanta University Resource Center in Science and Engineering

Introduction of Keynote Speaker: F. JAMES RUTHERFORD, Assistant Director for Science Education, National Science Foundation

Keynote Address

WALTER E. MASSEY, Dean of The College, Brown University

Training Minorities for the Science Careers of the Future

Jefferson Room 10:00 a.m. - 10:30 a.m. COFFEE BREAK

TIME PERIOD 7 REINFORCEMENT OF ACADEMIC SKILLS
FOUR CONCURRENT SESSIONS 10:30 a.m. - 12:00 noon

Session I
Lincoln Room East

Moderator: AJEET RANDHAWA, Voorhees College

Participants: RICHARD ROSS, Pan American University

The Development of an Academic Support Facility for the Sciences

J. HENRY SAYLES, Bennett College

The Guided Initiative Academic Advancement Reinforcement Systems Approach - A Viable Alternative to Traditional Science Education

Session II
Lincoln Room West

Moderator: FAUSTINE PERHAM, Central YMCA Community College

Participants: DARIUS MOVASSEGHI, Medgar Evers College

Development of Basics in Mathematics and The Sciences; "Lecture-Laboratory Format"

MICHAEL CAMPBELL, Our Lady of the Lake University

Student Motivation and Achievement at Our Lady of the Lake University

Session III
Military Room

Moderator: BETTAIYA RAJANNA, Selma University

Participants: MARY ABKEMEIER, LaGuardia Community College

Reinforcement of Basic Skills in Chemistry I Course

PHILLIP McNEIL, Norfolk State College

Reinforcement of Computational Skills at Norfolk State College

Session IV
Hemisphere Room

Moderator: GENARO GONZALEZ, Texas A&I University

Participants: ARGELIA VELEZ RODRIGUEZ, Bishop College

Eliminating "Mathematical Illiteracy" at the Freshman Level: A Modularized Mathematics Program

MAHENDRA KAWATRA, Medgar Evers College

Development of Supportive Materials in Mathematics and Science in a Lecture-Laboratory Format

Jefferson Room 2:30 p.m. - 3:00 p.m. COFFEE BREAK

TIME PERIOD 9 GENERAL INSTRUCTIONAL STRATEGIES
FOUR CONCURRENT SESSIONS 3:00 p.m. - 4:00 p.m.

Session I
Lincoln Room East

Moderator: JAMES PERKINS, Jackson State University

Participants: GEORGE KOLODIY, LaGuardia Community College

What does Piaget Tell Us About Teaching Science?

BETTAIYA RAJANNA, Selma University

Strategies in Science Instruction in a Junior College Setting

Session II
Lincoln Room West

Moderator: JOYCE CORRINGTON, Xavier University

Participants: AJEET RANDHAWA, Voorhees College

Instructional Strategies in The Natural Sciences

THOMAS McALLISTER, Jackson State University

Application of Techniques and Technology of Social Science Instruction

Session III
Military Room

Moderator: CARL POLOWCZYK, Bronx Community College

Participants: FREDERICK DUMSER, JR., Community College of Baltimore

Integration and Interfacing of Instructional Technologies: The Application of the Principles of Learning Theory to Instructional Design

TIMOTHY HUNT, Southwestern Christian College

Using a Videocassette System as a Part of an Effective Instructional Strategy

Session IV
Hemisphere Room

Moderator: MARCELINA VELEZ DE SANTIAGO, Catholic University of Puerto Rico

Participants: CARL HIME, Navajo Community College, Tsaile

Culture Sensitive, Quality Science Education at Navajo Community College

LENDWELL BRAUD, Texas Southern University

The Use of Programmed Units and Learning Objectives in an Experimental Psychology Undergraduate Class

12:00 noon - 1:15 p.m. **LUNCH BREAK**

TIME PERIOD 8 **INTERDISCIPLINARY COURSES AND CAREER OPPORTUNITIES**
FOUR CONCURRENT SESSIONS **1:15 p.m. - 2:30 p.m.**

Session I
Lincoln Room East

Moderator: MANUEL GOMEZ RODRIGUEZ, University of Puerto Rico, Rio Piedras Campus

Participants: RONALD SELSBY, University of Puerto Rico, Rio Piedras Campus

On-The-Job Training of Students in Computer Science

CLEMMIE WEBBER, South Carolina State College

An Interdisciplinary Seminar in the Behavioral, Natural and Social Sciences

Session II
Lincoln Room West

Moderator: BARBARA THOMPSON, Dillard University

Participants: KATHRYN BRISBANE, Spelman College

Urban-Environmental Studies: An Interdisciplinary Approach

ISABEL BALL, Our Lady of the Lake University

A Capstone Interdisciplinary Course in Values and the Sciences for the General Education Curriculum

Session III
Military Room

Moderator: RUTH BRADY, Alcorn State University

Participants: MEL SEIFERT, Sheldon Jackson College

Development of an Aquaculture Training Program in Alaska for Minority Students

ELMER WASHINGTON, Chicago State University

Internships: Achieving Lindages between Scientific Disciplines

Session IV
Hemisphere Room **1:15 p.m. - 2:30 p.m.**

Moderator: LINDA PETTY, Hampton Institute

Participants: TAE NAM, University of Arkansas at Pine Bluff

Career Opportunities in Science

WILLIAM NELSON, Paine College

The Challenge of Interdisciplinary Studies

TIME PERIOD 10 **GENERAL SESSION**
International Ballroom East **4:00 p.m. - 5:00 p.m.**

Presiding: KOOSAPPA RAJASEKHARA

Final Evaluation: WILLIAM McALLISTER, National Opinion Research Center

Travel Reimbursement Procedure: KOOSAPPA RAJASEKHARA

Concluding Remarks: SHIRLEY MALCOM

ADJOURNMENT

BARBER-SCOTIA COLLEGE, INC. ★ CONCORD 1867 NORTH CAROLINA ★
LUMEN VERITAS ET UTILITAS

XI. LIST OF REGISTERED PARTICIPANTS

LIST OF REGISTERED PARTICIPANTS

Abkemeier, Mary, LaGuardia Community College, CUNY, Long Island City, NY 11101 (NS)
Acosta, Gisela, InterAmerican University, Fajardo Branch, Fajardo, PR 00648 (NS)
Acosta, Martin, San Juan Technical Community College, Santurce, PR 00907 (NS)
Addison, Carolyn, Passaic City Community College, Patterson, NJ 07505 (NS)
Adeyemi, Gloria, National Science Foundation, Washington, DC 20550
Agnew, Bob, El Centro College, Dallas County Community College, Dallas, TX 75202 (NS)
Ahshapanek, Don, Haskell Indian Junior College, Lawrence, KS 66044 (NS)
Alam, M.I., LeMoyne-Owen College, Memphis, TN 38126 (NS)
Ali, Radman, Morris College, Sumter, SC 29150 (NS)
Aponte, Juan, InterAmerican University of Puerto Rico, Barranquitas, PR 00618 (NS)
Arafe, Thomas, Rust College, Holly Springs, MS 38635 (SS)
Arrington, James, South Carolina State College, Orangeburg, SC 29117 (NS)
Asfaw, Fisaha, Benedict College, Columbia, SC 29204 (SS)
Ault, Leslie, CUNY, Hostos Community College. Bronx, NY 10451 (SS)
Aviles, Norma, InterAmerican University of Puerto Rico, Barranquitas, PR 00618 (SS)
Baca, Ernest, Pan American University, Edinburg, TX 78539 (NS)
Bajwa, Jaswant, Edward Waters College, Jacksonville, FL 32209 (NS)
Bale, S.S., St. Paul's College, Lawrenceville, VA 23868 (NS)
Ball, Sr. Isabel, Our Lady of the Lake University, San Antonio, TX 78285 (NS)
Ball, Rex, Laredo State University, Laredo, TX 78040 (SS)
Barnett, William, Lincoln University, Jefferson City, MO 65101 (SS)
Barrett, Helen, Tennessee State University, Nashville, TN 37203 (SS)
Barrett, Roy, Fayetteville State University, Fayetteville, NC 28301 (NS)
Baxter, James, Shelby State Community College, Memphis, TN 38104 (SS)
Beck, James, Virginia State College, Petersburg, VA 23803 (NS)
Bell, Della, Texas Southern University, Houston, TX 77004 (NS)
Bell, James A., Laredo State University, Laredo, TX 78040 (NS)
Bell, James D., El Paso Community College, El Paso, TX 79904 (SS)
Bellamy, Donnie, Fort Valley State College, Fort Valley, GA 31030 (SS)
Bertha, J., Friendship Jr. College, Rock Hill, SC 29730 (SS)
Bertin, Felix Liard, Puerto Rico Junior College, Rio Piedras, PR 00928 (NS)
Bindel, Rosalie, Institute of American Indian Arts, Sante Fe, NM 87501 (SS)
Binford, Jane, Houston Community College, Houston, TX 77007 (NS)
Bishop, Clyde, U.S. EPA, Washington, DC 20460
Black, Billy, Albany State College, Albany, GA 31705 (NS)
Blackmon, Yolanda M., Howard University, Washington, DC 20059
Blair, Thomas D., U.S. General Accounting Office, Columbia, MD 21045
Bobo, Betty, Coahoma Junior College, Clarksdale, MS 38614 (NS)
Boehmer, Cecile, Alice Lloyd College, Pippa Passes, KY 41844 (NS)
Bolden, Otis, St. Louis Community College @ Forest Park, St. Louis, MO 63110 (SS)
Bonilla, Alex, University of Puerto Rico, Rio Piedras, PR 00931 (NS)
Bonham, Kenneth, Institute of American Indian Arts, Sante Fe, NM 87501 (NS)
Bowie, Joyce, Texas College, Tyler, TX 75702 (SS)
Boyd, Robert, Livingstone College, Salisbury, NC 28144 (NS)
Brady, Laurene, Oglala Sioux Community College, Pine Ridge, SD 57770 (NS)

Brady, Ruth, Alcorn State University, Lorman, MS 39096 (NS)
Braud, Lendell, Texas Southern University, Houston, TX 77004 (SS)
Braxter, Samuel, Lane College, Jackson, TN 38301 (NS)
Braxton, Rueben, CUNY Borough of Manhattan Community College, New York, NY 10019 (SS)
Briggs, Lee, Navajo Community College, Shiprock, NM 82420 (NS)
Bright, Bobra C., Miles College, Birmingham, AL 35208
Brimelow, Frank, Voorhees College, Denmark, SC 29042 (SS)
Brisbane, Kathryn, Spelman College, Atlanta GA 30314 (SS)
Brockman, John, Bee County College, Beeville, TX (SS)
Brookins, Geraldine, Jackson State University, Jackson, MS 39206 (SS)
Brotherton, Frank, Xavier University, New Orleans, LA 70125 (SS)
Brown, Kenneth, Navajo Community College, Shiprock Branch, Shiprock, NM 87420 (SS)
Brown, Paul, Atlanta University Resource Center, Atlanta, GA 30314 (NS)
Brown, William, U.S. Department of Transportation, Washington, DC 20590
Brucker, Diane, Science Media, Boca Raton, FL 33432
Bulla, Isabell, InterAmerican University, Fajardo Branch, Fajardo, PR 00648 (NS)
Bullard, Robert, Texas Southern University, Houston, TX 77004 (SS)
Burrows, Rodney, Fayetteville State University Fayetteville, NC 28301 (SS)
Bush, Charles, Community College of Philadelphia, Philadelphia, PA 19107 (SS)
Bussie, Ruth T., National Bureau of Standards, Dept. of Commerce, Washington, DC 20234
Bynum, Elward, National Institutes of Health, Bethesda, MD 20014
Byrd, Lanier, St. Phillip's College, San Antonio, TX 78203 (NS)
Cady, Frank W., National Institutes of Health, Bethesda, MD 20014
Caine, Rufus, University of Arkansas, Pine Bluff, AR 71601 (NS)
Caldwell, Eleanor F., City Colleges-Chicago, Kennedy-King, Chicago, IL 60616
Caldwell, R.C., Shorter College, North Little Rock, AR 72114 (NS)
Calkins, H.E., Paul Quinn College, Waco, TX 76704 (NS)
Camp, Frank, Friendship Junior College, Rock Hill, SC 29730
Campbell, Betty, Trident Technical College, Charleston, SC 29411 (SS)
Campbell, Delores B., Jackson State University, Jackson, MS 39217
Campbell, Michael, Our Lady of the Lake University, San Antonio, TX 78285 (SS)
Cantor, Cliff, Kuskokwim Community College, Bethel, AK 99559 (NS)
Castillo, Josue, Caribbean Junior College, Bayamon, PR 00619 (SS)
Catchings, Clemontine, Coahoma Junior College, Clarksdale, MS 38614 (NS)
Catchings, Robert, Howard University, Washington, DC 20059 (NS)
Chapman, Ames, Central State University, Wilberforce, OH 45384 (NS)
Chen, David, Denmark Technical Educational Center, Denmark, SC 29042 (NS)
Chetty, K., Mississippi Industrial College, Holly Springs, MS 38635 (NS)
Chu, Kwo-Sun, Talladega College, Talladega, AL 35160 (NS)
Chu, Raymond, Chicago State University, Chicago, IL 60628 (NS)
Clark, Donald, Highland Park Community College, Highland Park, MI 48203 (NS)
Clark, Ronald, New Mexico Highlands University, Las Vegas, NM 87701 (NS)
Cohen, David, Long Island University, Brooklyn Center, Brooklyn, NY 11201 (NS)

Cole, Larry, Prairie View A&M University, Prairie View, TX 77445 (NS)
Cole, Thomas, Atlanta University, Atlanta, GA 30314 (NS)
Colinet, Gilde, Olive Harvey College, Chicago, IL 60628 (NS)
Collins, L.C., Johnson C. Smith University, Charlotte, NC 28216 (NS)
Cooper, E.A., Oakwood College, Huntsville, AL 35806 (NS)
Cornwell, Henry, Lincoln University, Lincoln University, PA 19352 (SS)
Copeland, Richard, Bethune-Cookman College, Daytona Beach, FL 32015 (NS)
Corrington, Joyce, Xavier University of Louisiana, New Orleans, LA 70125 (NS)
Cotton, Bernard, Alcorn State University, Lorman, MS 39096 (SS)
Culmer, Darla, Florida Memorial College, Miami, FL 33054 (NS)
Curtain, Annie, Morris College, Sumter, SC 29105 (SS)
Dames, Vivian, University of Guam, Agana, Guam 96910 (SS)
Daniel, Kesete, Roxbury Community College, Roxbury, MA 02119 (NS)
Daniel, Victor, South Carolina State College, Orangeburg, SC 29117 (NS)
Darden, Geraldine, Hampton Institute, Hampton, VA 23668 (NS)
David, Arthur, Lane College, Jackson, TN 38301 (SS)
Davis, John, Southern University, Shreveport, LA 71107 (NS)
Davis, Joyce, Bee County College, Beeville, TX 78102 (NS)
Davis, Patrick, Essex County College, Newark, NJ 07102 (NS)
De la Garza, Cesar, Del Mar College, Corpus Christi, TX 78404 (SS)
DeBerry, Roy, Mississippi Industrial College, Holly Springs, MS 38635 (SS)
DeRemer, Charles, Turtle Mountain Community College, Belcourt, ND 58316 (NS)
De Ruiz, Neris, InterAmerican University of Puerto Rico, Arecibo, PR 00612 (NS)
Dell'Orto, Joan, Atlanta Junior College, Atlanta GA 30310 (NS)
Deringer, Dorothy, National Science Foundation, Washington, DC 20550
Diggs, Julia, National Science Foundation, Washington, DC 20550
Dolney, Edwin, Claflin College, Orangeburg, SC 29115 (NS)
Doman, Elvira, National Science Foundation, Washington, DC 20550
Doub, Ron, Morgan State University, Baltimore, MD 21239
Dumser, Frederick, Commuity College of Baltimore, Baltimore, MD 21215 (NS)
Dunbar, Morris, Wayne County Community College, Detroit, MI 48201 (NS)
Duncan, Nancy, Hampton Institute, Hampton, VA 23661 (SS)
Dunn, S. Burgin, Texas A & I University, Kingsville, TX 78363 (SS)
Edwards, Canto H., Howard University, Washington, DC 20059 (NS)
Edwards, Gerald A., National Science Foundation, Washington, DC 20550
Edwards, Thomas, Coahoma Junior College, Clarksdale, MS 38614 (SS)
Elias, Walter, Virginia State College, Petersburg, VA 23803 (NS)
Erdman, Clara, Alice Lloyd College, Pippa Passes, KY 41844 (SS)
English, Allen, Selma University, Selma, AL 36701 (SS)
Ertel, John, Highland Park Community College, Highland Park, MI 48203 (SS)
Feng, Alan, Cheyney State College, Cheyney, PA 19319 (SS)
Ferguson, Thomas, Delaware State College, Dover, DE 19901 (NS)

Fernandez-Minguez, Serapio, University of Puerto Rico, Regional Colleges Administration, Rio Piedras, PR 00931 (SS)

Finkelstein, Isabella, Clark College, Atlanta, GA 30314 (NS)

Fishman, Robert, Clark College, Atlanta, GA 30314 (SS)

Foust, Ben, Paul D. Camp Community College, Franklin, VA 23851 (NS)

Furr, Marion, Paine College, Augusta, GA 30961 (NS)

Gallardo, Julio A., Hostos Community College of CUNY, Bronx, NY 11451 (NS)

Gambill, Charles, Del Mar College, Corpus Christi, TX 78404 (NS)

Garner, John, Tougaloo College, Tougaloo, MS 39174 (NS)

Gasden, Rachel, Birmingham Board of Education, Birmingham, AL 35217 (SS)

Gaston, Patricia, Lawson State Community College, Birmingham, AL 35221 (SS)

Gatzke, D.A., Northwest Community College, Nome, AK 99762 (SS)

Gayles, Joseph N., Jr., Talladega College, Talladega, AL 35160 (NS)

Gentry, Roosevelt, Jackson State University, Jackson, MS 39217 (NS)

Ghose, Hirendra M., Cuyahoga Community College, Metro Campus, Cleveland, OH 44120 (NS)

Gibson, Everett, Southern University, Baton Rouge, LA 70813 (NS)

Gilliam, Reneé Patrice, Kentucky State University, Frankfort, KY 40601 (NS)

Gjessing, Helen, College of the Virgin Islands, St. Thomas, VI 00801 (NS)

Glowienka, Emerine Universtiy of New Mexico, Gallup Branch, Gallup, NM 87301 (SS)

Gomes, Ralph, Howard University, Washington, DC 20054 (SS)

Gomez-Rodriguez, Manuel, University of Puerto Rico, Rio Piedras Campus, Rio Piedras, PR 00931 (NS)

Gonzales, Ciriaco, National Institutes of Health, Bethesda, MD 20014

Gonzalez, Genaro, Texas A & I University, Kingsville, TX 78363 (NS)

Gonzalez, Patricia, Bayamon Central University, Bayamon, PR 00619 (NS)

Gooden, Curtis L., Cuyahoga Community College, Metro Campus, Cleveland, OH 44115 (SS)

Goodin, Margaret, Paul Quinn College, Waco, TX 76704 (SS)

Grayson, George, Alabama A & M University, Normal, AL 35762 (NS)

Griffith, Albert, Our Lady of the Lake University, San Antonio, TX 78285 (NS)

Gurley, Lawrence, Merritt College, Oakland, CA 94619 (NS)

Hale, Duane, Navajo Community College, Tsaile, AZ 86556 (SS)

Halfond, Irwin, Livingstone College, Salibury, NC 28144 (SS)

Hall, Evelyn, Morris College, Sumter, SC 29150 (SS)

Hall, John, Morehouse College, Atlanta, GA 30314 (NS)

Hall, John H., Atlanta University Center, Atlanta, GA 30314 (NS)

Hankerson, James, El Centro College, Dallas, TX 75202 (SS)

Harcharek, Robert, Inupiat University of the Arctic, Barrow, AK 99723 (SS)

Hardester, Laura, Southern University in New Orleans, New Orleans, LA 70126 (NS)

Hargrove, Rachael, Virginia Union University, Richmond, VA 23220 (NS)

Harmon, Linia, Bacone College, Muskogee, OK 74401 (NS)

Harper, B.F., Utica Junior College, Utica, MS 39175 (NS)

Harris, Winfred, NIH/MARC Program, Bethesda, MD 20014

Harvey, Robert, National Science Foundation, Washington, DC 20550

Hastie, Windell G., Friendship College, Rock Hill, SC 29730

Hayes, Jack, Paine College, Augusta, GA 30901 (NS)
Hayles, Robert, Office of Naval Research, Arlington, VA 22217
Heard, James, The City College of Chicago, Loop College, Chicago, IL 60601 (SS)
Heil, Celia, National Science Foundation, Wasington, DC 20550
Hemphill, Leslie, Haskell Indian Junior College, Lawrence, KS 66044 (SS)
Henderson, Gordon, Tougaloo College, Tougaloo, MS 39174 (SS)
Henderson, Jerry, St. Louis Community College @ Forest Park, St. Louis, MO 63110 (NS)
Henniger, Lux, City College of Chicago, Kennedy-King, Chicago, IL 60621 (SS)
Hensley, Michael, Paul D. Camp Community College, Franklin, VA 23851 (NS)
Herrington, Deloris, Allen University, Columbia, SC 29204 (NS)
Hetzler, Stan, Wilberforce University, Wilberforce, OH 45384 (SS)
Hicks, Arthur, North Carolina A & T State University, Greensboro, NC 27411 (NS)
Hime, Carl, Navajo Community College, Tsaile, AZ 87556 (NS)
Hirshon, Jordon, Long Island University, Brooklyn Center, Brooklyn, NY 11201 (NS)
Hofster, Adrian, Knoxville College, Knoxville, TN 37921 (NS)
Hollander, Robert, St. Louis Community College @ Forest Park, St. Louis, MO 63116 (SS)
Hollis, Meldon, Department of H.E.W., Washington, DC 20202
Hope, Richard, Morgan State University, Baltimore, MD 21239 (SS)
Hopkins, Thomas, University of Maryland @ Eastern Shore, Princess Anne, MD 21853 (NS)
Horton, Carrell, Fisk University, Nashville, TN 37203 (SS)
Horton, John, Roanoke-Chowan Technical Institute, Ahoskie, NC 27910 (SS)
Howard, J.T., Bishop College, Dallas, TX 75241 (SS)
Hu, Paula, Malcolm X College, Chicago, IL 60612 (SS)
Huffaker, William, Vance-Granville Community College, Henderson, NC 27536 (NS)
Hughes, Bill, Southwestern Christian College, Terrell, TX 75160 (SS)
Hull, George, Fisk University, Nashville, TN 37203 (NS)
Humphrey, Charles, Kentucky State University, Frankfort, KY 40601
Hunt, John, Science Media, Boca Raton, FL 33432
Hunt, Timothy, Southwestern Christian College, Terrell, TX 75160 (NS)
Hunte, Beryl, CUNY Borough of Manhattan Community College, New York, NY 10019 (NS)
Igbokwe, Emmanuel, Rust College, Holly Springs, MS 38635 (NS)
Jackson, Avra, Department of Commerce, Rockville, MD 20852
Jackson, Cynthia, Lawson State Community College, Birmingham, AL 35221 (NS)
Jackson, Rosalyn, Southern University, Shreveport, LA 71107 (SS)
Jackson, Samuel, Trenholm State Technical College, Montgomery, AL 36008 (NS)
Jackson, William M., Howard University, Washington, D.C. 20059 (NS)
Jacobs, Bruce, Laney College, Oakland, CA 94607 (NS)
James, Felix, Southern University in New Orleans, New Orleans, LA 70126 (SS)
James, Margaret, LeMoyne-Owen College, Memphis, TN 38126 (SS)
James, Spensin, Community College of Micronesia, Kolonia, Ponape Island, E. Caroline Islands, Micronesia 96941 (NS)
Jankowski, Ann, National Bureau of Standards, Washington, DC 20234
Jao, Tze Chi, University of Puerto Rico, Mayaguez, PR 00708 (NS)
Jennings, James, State Community College, East St. Louis, IL 62201 (SS)

Jerry, Timothy, Community College of Micronesia, Kolonia, Ponape Island, E. Caroline Islands, Micronesia 96941 (NS)

Johnson, Earl, Houston Community College, Houston, TX 77007 (NS)

Johnson, James, Howard University, Washington, DC 20059 (NS)

Johnson, W.W., St. Augustine's College, Raleigh, NC 27611 (NS)

Jones, Edythe B., Talladega College, Talladega, AL 35160 (NS)

Jones, Jesse, Bishop College, Dallas, TX 75241 (NS)

Jones, John R., Knoxville College, Knoxville, TN 37921 (SS)

Jordan, James, Otica Junior College, Otica, MS 39175 (SS)

Joshi, Narayan, Coppin State College, Baltimore, MD 21216 (NS)

Kaskas, James, Detroit Institute of Technology, Detroit, MI 48201 (NS)

Kaushik, Suresh, H.C. Trenholm State Technical College, Montgomery, AL 36008 (NS)

Kawatra, Mahendra, CUNY Medgar Evers College, Brooklyn, NY 11225 (NS)

Kellett, James C., Department of Energy, Washington, DC 20545

Kennedy, Amos, Grambling State University, Grambling, LA 71245 (NS)

Kenny, Alden, Passaic Community College, Patterson, NJ 07505 (SS)

Kidder, Alice, North Carolina A & T State University, Greensboro, NC 27411 (SS)

Kiley, Fran, National Science Foundation, Washington, DC 20550

Kinard, James, Benedict College, Columbia, SC 29204 (NS)

Kirk, Sarah, North Carolina A & T State University, Greensboro, NC 27411 (SS)

Kirsch, Robert, Claflin College, Orangeburg, SC 29915 (SS)

Knox, Mavis, Nairobi College, East Palo Alto, CA 94303 (SS)

Kocolowski, Gary, Dyke College, Cleveland, OH 49114 (SS)

Koons, L.F., Tuskegee Institute, Tuskegee Institute, AL 36088 (NS)

Kopely, Richard A., Howard University, Washington, DC 20059

Korn, Abe, New York Community College, Brooklyn, NY 11211 (NS)

Kunath, Gus, G K Instruments, Inc., Montevallo, AL 35115

Ladner, Kenneth, Western New Mexico University, Silver City, NM 88061 (NS)

Lammers, Sr. Barbara, Donnelly College, Kansas City, KS 66102 (NS)

Lawson, Thomas H., Jr., Howard University, Washington, DC 20059

Lawson, Valarie J., Howard University, Washington, DC 20059

Lea, Robert, CUNY City College, New York, NY 10031 (NS)

Leonhard-Spark, Phillip, CUNY City College, New York, NY 10031 (SS)

Leung, Eric, Philander Smith College, Little Rock, AR 72203 (SS)

Lewis, Frank, Lomax-Hannon Junior College, Greenville, AL 36037 (NS)

Lewis, Jesse, Jackson State University, Jackson, MS 39217 (NS)

Lewis, Leslie, CUNY York College, Jamaica, NY 11451 (NS)

Lewis, Rachael O., Philander Smith College, Little Rock, AR 72203

Lieberman, Jane, LaGuardia Community College, Long Island City, NY 11101 (SS)

Lindsay, Herbert, Morgan State University, Baltimore, MD 21212

Lockett, James, Stillman College, Tuscaloosa. AL 35401 (SS)

Loeen, Carl, Virginia Union University, Richmond, VA 23220 (SS)

Love, William, College of Alameda, Alameda, CA 94501 (SS)

Lovett, Bobby, Tennessee State University, Nashville, Tn 37203 (SS)
McAllister, Thomas, Jackson State University, Jackson, MS 39217 (SS)
McAllister, William T., National Opinion Research Center, University of Chicago, Chicago, IL 60637
McBay, Shirley, National Science Foundation, Washington, DC 20550
McCarther, Cynthia, Morristown College, Morristown, TN 37814 (NS)
McClain, William, Alabama Lutheran Academy and College, Selma, AL 36701 (NS)
McCormick, John E., Sargent-Welch Scientific Company, Springfield, NY 11590
McConnell, Robert, Trident Technical College, Charleston, SC 29411 (NS)
McCoy, William, Department of the Interior, Washington, DC 20240
McCullough, Bleaher, Friendship College, Rock Hill, SC 29730 (SS)
McGeagh, Bob, Northern New Mexico Community College, El Rito, NM 87530 (SS)
McGruder, Penny, National Science Foundation, Washington, DC 20550
McGuire, Howard, Long Island University, Brooklyn, NY 11201 (SS)
McGuire, Nancy, Northwest Community College, Nome, AK 99762 (NS)
McIver, Isiah, Savannah State College, Savannah, GA 31404 (SS)
McKenna, George, Xavier University, New Orleans, LA 70125 (SS)
McLean, Jimmy, Mary Holmes College, West Point, MS 39773 (SS)
McLean, Mable P., Barber-Scotia College, Concord, NC 28025
McLemore, Leslie, Jackson State University, Jackson, MS 33217 (SS)
McLeod, John, Morris Brown College, Atlanta, GA 30314 (NS)
McMillan, N., St. Paul's College, Lawrenceville, VA 23868 (SS)
McNeil, Philip, Norfolk State College, Norfolk, VA 23504 (NS)
McPhee, Joseph, CUNY LaGuardia Community College, Long Island City, NY 11101 (NS)
Maestas, Sigfredo, New Mexico Highlands University, Las Vegas, NM 87701 (NS)
Maier, Tom, Atlanta Junior College, Atlanta, GA 30310
Majid, Ligia Pabon de, University of Puerto Rico, Cayey, PR 00633 (NS)
Malcom, Shirley, National Science Foundation, Washington, DC 20550
Mancini, Edward T., Brickmann Instruments, Inc., Westbury, NY 11590
Marshall, General, Huston-Tillotson College, Austin, TX 78702 (NS)
Martin, Donald, Bennett College, Greensboro, NC 27420 (SS)
Martin, Joe, Houston Community College, Houston, TX 77007 (SS)
Martin, Larry, Coppin State College, Baltimore, MD 21216 (SS)
Martin, Vincent, Shaw College at Detroit, Detroit, MI 48202 (SS)
Martinez, Arthur, Western New Mexico University, Silver City, NM 88061 (SS)
Martinez, Jose, Texas State Technical Institute, Harlingen, TX 78550 (NS)
Martinez, Joseph V., U.S. Department of Energy, Washington, DC 20545
Masingale, Robert, Jarvis Christian College, Hawkins, TX 75765 (NS)
Massey, Walter, Brown University, Providence, RI 02912 (NS)
Mathur, R., St. Paul's College, Lawrenceville, VA 23868 (NS)
Medina-Talavera, Jose, InterAmerican University, Agudilla, PR 00603 (NS)
Medrano, Manuel, Texas Southmost College, Brownsville, TX 78520 (SS)
Mendez, Antonio, Caribbean Junior College (University), Bayamon, PR 00619 (NS)

Miles, Merle, Huston-Tillotson College, Austin, TX 78702 (SS)
Miller, Albert, Delaware State College, Dover, DE 19901 (SS)
Miller, Calvin, Virginia State College, Petersburg, VA 23803 (SS)
Miller-Stevens, Louise, Spelman College, Atlanta, GA 30314 (NS)
Mills, Frank, College of the Virgin Islands, Saint Thomas, VI 00801 (SS)
Mills, Maurice, Wiley College, Marshall, TX 75670 (NS)
Minguez, Serapio, InterAmerican University of Puerto Rico, Arecibo, PR 00612 (SS)
Miskimen, George, University of Puerto Rico, Mayaguez, PR 00708 (NS)
Mitchell, Claude, Cheyney State College, Cheyney, PA 19319 (SS)
Moore, Bernice, Barber-Scotia College, Concord, NC 28025 (SS)
Moorehead, William, Ft. Valley State College, Ft. Valley, GA 31030 (NS)
Moran, Jean Donnelly College, Kansas City, KS 66102 (NS)
Mori, Roberto, University of Puerto Rico, Humacao University College, Humacao, PR 00661(SS)
Morrill, Peter B., Bronx Community College, Bronx, NY 10453 (SS)
Morris, Douglas, Talladega College, Talladega, AL 35160
Morris, Herbert, Arkansas Baptist College, Little Rock, AR 72202 (NS)
Morris, Joseph B., Howard University, Washington, DC 20059 (NS)
Morrison, Jeanne, Talladega College, Talladega, AL 35160 (SS)
Mortenson, Albert, Compton Community College, Compton, CA 90021 (SS)
Movasseghi, Darius, CUNY Medgar Evers College, Brooklyn, NY 11225 (NS)
Mukenge, T., Morris Brown College, Atlanta, GA 30314 (SS)
Muniz, Luis, InterAmerican University of Puerto Rico, Fajardo, PR 00648 (SS)
Munox, Alfredo, Texas Southmost College, Brownsville, TX 78520 (NS)
Munoz, Rafael, InterAmerican University, San Juan, PR 00936 (NS)
Muriel, Amador, (on leave from Hostos Community College) Burlington County Community College, Pemberton, NJ 08068 (NS)
Murray, Jan, Standing Rock Community College, Fort Yates, ND 58538 (SS)
Nam, Tae, University of Arkansas @ Pine Bluff, AR 71601(SS)
Neeley, Doug, Colegio Cesar Chavez, Mt. Angel, OR 97362 (NS)
Nelson, Lynda, Prentiss Normal and Industrial Institute, Prestiss, MS 39474 (NS)
Nelson, William, Paine College, Augusta, GA 30901 (SS)
Newsome, Vickie, Durham Technical Institute, Durham, NC 27707 (SS)
Nichols, Woodrow, North Carolina Central University, Durham, NC 27707 (SS)
Nix, Charles, Jarvis Christian College, Hawkins, TX 75765 (SS)
Nwosu, Patrick N., Jr., Friendship College, Rock Hill, SC 29730 (NS)
Ochoa, Edward, El Paso Community College, El Paso, TX 79904 (NS)
O'Conner, James V., University of D.C., Reston, VA 22092 (NS)
Ogonji, Gilbert, Coppin State College, Baltimore, MD 21216 (NS)
Oliver, Larry, National Science Foundation, Washington, DC 20550
Olson, Ronald, Laredo Junior College, Laredo, TX 78040 (SS)
Otriz, Eduardo, World University, Hato Rey, PR 00917
Padmore, Lynette, Florida A & M University, Tallahassee, FL 32307 (NS)
Pai, Paul Pu, Denmark Technical Institute, Denmark, SC 29042 (NS)
Parker, Drucilla P., D.Q. University, Davis, CA 95612

Parker, Stephan, Chicago State Unviversity, Chicago, IL 60628 (SS)
Patel, Kanti, Shaw University, Raleigh, NC 27611 (NS)
Patterson, Joseph, Atlanta Junior College, Atlanta, GA 30310 (NS)
Payton, Albert, Mississippi Valley State University, Itta Bena, MS 38941 (NS)
Pearlstein, Ned, Laney College, Oakland, CA 94607 (SS)
Peguese, Robbie, Benedict College, Columbia, SC 29204 (SS)
Pellet, Pedro, Sacred Heart University, Santurce, PR 00914 (SS)
Perez, Claudio, Laredo Junior College, Laredo, TX 78040 (NS)
Perham, Faustine, Central YMCA Community College, Chicago, IL 60606 (NS)
Perkins, James, Jackson State University, Jackson, MS 39217 (NS)
Perrow, Cecelia, New Mexico State University, Grants, NM 87020 (NS)
Petterson Robert, State Community College, East St. Louis, IL 62201 (SS)
Petress, President, Friendship Junior College, Rock Hill, SC 29730
Phillips, Juliatte, Oakwood College, Huntsville, AL 35806 (NS)
Piper, Carolyn, National Science Foundation, Washington, DC 20550
Pohly, Jurgen, National Aeronautics and Space Administration, Washington, DC 20546
Polowczyk, Carl, CUNY Bronx Community College, Bronx, NY 10453 (NS)
Pomilla, Frank, CUNY York College, Jamaica, NY 11451 (NS)
Ponds, Johnny, Bowie State College, Bowie, MD 20715 (NS)
Poole, Richard, Lummi Indian School of Aquaculture, Lummi Island, WA 98202 (NS)
Porcher, Martha, Barber-Scotia College, Concord, NC 28025
Pottinger, Sr. Aelred, Donnelly College, Kansas City, KS 66102 (SS)
Powell, E.C., Texas Southern University, Houston, TX 77004 (SS)
Powers, Maurice, Elizabeth City State University, Elizabeth City, NC 27909 (NS)
Preston, Walton, U.S. Environmental Protection Agency, Washington, DC 20460
Prewitt, Kenneth, National Opinion Research Center, University of Chicago, Chicago, IL 60637
Privett, James, Amerian Indian Satellite Community College, Winnebago, NE 68171 (NS)
Pruden, Rudolph B., NOAA-OAS, Washington, DC 20024
Puri, O.P., Clark College, Atlanta, GA 30314 (NS)
Pyles, Julian, Barber-Scotia College, Concord, NC 28025 (NS)
Rajanna, B., Selma University, Selma, AL 36701 (NS)
Rajasekhara, Koosappa, Barber-Scotia College, Concord, NC 28025 (NS)
Ramirez, Salvador, Colegio Cesar Chavez, Mount Angel, OR 97362 (NS)
Ramos, Augustin Rios, Colegio Universitario del Turbo, Caguas, PR 00625 (NS)
Randhawa, Ajeet, Voorhees College, Denmark, SC 29042 (NS)
Raulerson, Lynn, University of Guam, Agana, Guam 96910 (NS)
Ravella, Ramesh, Mary Holmes College, West Point, MS 39773 (NS)
Ray, Jacqueline, CUNY York College, Jamaica, NY 11451 (SS)
Reed, Jasper, Community College of Philadelphia, Philadelphia, PA 19107 (NS)
Reghaby, Heydar, D.Q. University, Davis, CA 95616 (NS)
Reichard, Don, Paul D. Camp Community College, Franklin, VA 23851 (SS)
Reid, Ed, Shelby State Community College, Memphis, TN 38104 (SS)
Reinhardt, Charles, Baltimore Community College, Baltimore, MD 21215 (SS)

Richardson, David, Kentucky State University, Frankfort, KY 40601 (NS)
Richardson, Edward, InterAmerican University, San Juan Campus, Hato Rey, PR 00919 (SS)
Richwine, Harold, Imperial Valley College, Imperial, CA 92251 (NS)
Ridgel, Gertrude C., Kentucky State University, Frankfort, KY 40601 (NS)
Rippy, Coleman, Johnson C. Smith University, Charlotte, NC 28216 (SS)
Rivera, Karen, San Juan Technical Community College, Santurce, PR 00907 (SS)
Rivers, Larry, Florida A & M University, Tallahassee, FL 32307 (SS)
Rivers, Prince, National Institutes of Health, Bethesda, MD 20014
Rivers, Rita, Daniel Hale Williams University, Chicago, IL 60664 (SS)
Roark, Roger R., B/R Instrument Corporation, Pasadena, MD 21122
Roberson, Ed, Prentiss Normal & Industrial Institute, Prentiss, MS 39474 (SS)
Robinson, Margaret C., Savannah State College, Savannah, GA 31404 (NS)
Robinson, Mary, Arkansas Baptist College, Little Rock, AR 72202 (SS)
Rodriguez, Argelia, Bishop College, Dallas, TX 75241 (NS)
Rodriguez, Jose, World University, Hato Rey, PR 00917 (NS)
Rodriguez, Maria, University of the Sacred Heart, Santurce, PR 00914 (NS)
Rodriguez, Paul, National Science Foundation, Washington, DC 20550
Roscoe, Wilma, NAFEO, Washington, DC 20009
Rosing, Herbert, City of Chicago, Loop College, Chicago, IL 60601 (NS)
Ross, Ernest, Detroit Institute of Technology, Detroit, MI 48201 (SS)
Ross, Richard, Pan American University, Edinburg, TX 78539 (NS)
Rudd, Sue, Gadsden State Junior College, Gadsden, AL 35903 (SS)
Ruiz, Sonia, University of Puerto Rico, Mayaquez Campus, Mayaquez, PR 00708 (SS)
Russell, Janet, Shaw College at Detroit, Detroit, MI 48202 (NS)
Rutherford, F. James, National Science Foundation, Washington, DC 20550
Ryan, Mary A., Xavier University of Louisiana, New Orleans, LA 70125 (NS)
Sailer, Bill, New Mexico State University, Grants Branch, Grants, NM 87020 (SS)
Saini, S.K., Wilberforce University, Wilberforce, OH 45384 (NS)
Samuel, Nelson, Oglala Sioux Community College, Pine Ridge, SD 57770 (NS)
Sandler, Barney, CUNY, New York City Community College, Brooklyn, NY 11201 (NS)
Sandoval, James, L.A. City College, Los Angeles, CA 90029 (NS)
Sankey, Ann, Lomax-Hannon Junior College, Greenville, AL 36037 (SS)
Santana, Isabel, Bayamon Central University, Bayamon, PR 00619 (SS)
Santealla, Teresa, Catholic University of Puerto Rico, Ponce, PR 00731 (SS)
Sawyer, Alfred, Nairobi College, East Palo Alto, CA 94303 (NS)
Sayles, J. Henry, Bennett College, Greensboro, NC 27420 (NS)
Schmitz, Robert, American Indian Satellite Community College, Winnebago, NE 68701 (SS)
Schoolland, Ken, Sheldon Jackson College, Sitka, AK 99835 (SS)
Schoolmaster, Mary Ellen, National Science Foundation, Washington, DC 20550
Seifert, Mel, Sheldon Jackson Junior College, Sitka, AK 99835 (NS)
Selsby, Ronald, University of Puerto Rico, Rio Piedras, PR 00931 (NS)
Sheehy, Ronald, Morehouse College, Atlanta, GA 30314 (NS)
Shepard, Joseph, S.D. Bishop State Junior College, Mobile, AL 36603 (NS)
Sickles, Patricia, National Science Foundation, Washington, DC 20550

Silber, Robert, L., National Science Teachers Association, Washington, DC
Simien, Anquenett, Huston-Tillotson College, Austin, TX 78702 (NS)
Simms-Brown, Ruby, Southern University, Baton Rouge, LA 70813 (SS)
Slaughter, John Etta, St. Phillip's College, San Antonio, TX 78203 (SS)
Smith, Barnett, Spelman College, Atlanta, GA 30314 (NS)
Smith, Frederick, Tennessee State University, Nashville, TN 39203 (NS)
Smith, Joseph, City College of Chicago, Olive Harvey College, Chicago, IL 60628 (NS)
Smith, Kara, Essex County College, Newark, NJ 07102 (SS)
Smith, Mack, Ministerial Institute and College, West Point, MS 39773 (NS)
Smith, Nadine, Beaufort Technical Educational Center, Beaufort, SC 29902 (NS)
Smith, Stanley, University of Illinois, Urbana, IL 61801 (NS)
Sobrian, Sonya K., National Science Foundation, Washington, DC 20550
Soltero, Sonia Cruz, University of Puerto Rico, Rio Piedras, PR 00931 (NS)
Sparks, Elbert, Stillman College, Tuscaloosa, AL 35401 (NS)
Spurling, John, Miles College, Birmingham, AL 35208 (SS)
Stallworth, Lewis, L.A. Southwest College, Los Angeles, CA 90047 (NS)
Stinson, Charlie M., Talladega College, Talladega, AL 35160 (NS)
Stokes, Jennifer, Daniel Hale Williams University, Chicago, IL 60644 (NS)
Stolar, John, Cheyney State College, Cheyney, PA 19319 (NS)
Stucke, Carl H., Atlanta Junior College, Atlanta, GA 30310 (NS)
Subbarao, S.C., Lincoln University, Lincoln University, PA 19352 (NS)
Sutton, William W., Dillard University, New Orleans, LA 70122 (NS)
Svager, Thyrsa, Central State University, Wilberforce, OH 45384 (NS)
Tabakian, Paul, L.A. Trade and Technical College, Los Angeles, CA 90015 (NS)
Talley, Marke, Northern New Mexico Community College, El Rito, NM 87530 (NS)
Taylor, Julius, Morgan State University, Baltimore, MD 21239 (NS)
Taylor,Tossie, Cheyney State College, Cheyney, PA 19319 (NS)
Teague, William, Texas College, Tyler, TX 75702 (SS)
Thomas, Lottie, Arkansas Baptist College, Little Rock, AR 72202 (NS)
Thompson, Barbara, Dillard University, New Orleans, LA 70122 (SS)
Thompson, Lloyd, Wiley College, Marshall, TX 75670 (SS)
Torres Rivera, Ivette, Cayey University College, Cayey, PR 00633 (SS)
Townes, Mary, North Carolina Central University, Durham, NC 27707 (NS)
Trix, Phelps, Detroit Institute of Technology, Detroit, MI 48201
Trotter, Robert, Pan American University, Edinburg, TX 78539 (SS)
Turcott, David, Sheldon Jackson College, Sitka, AK 99835 (NS)
Turnage, Curtis, Elizabeth City State University, Elizabeth City, NC 27909 (NS)
Twine, Everett, Los Angeles Southwest College, Los Angeles, CA 90047 (SS)
Ugoji, Alalazu, S.D. Bishop State Junior College, Mobile, AL 36603 (SS)
Valasquez, Carmen, Catholic University of Puerto Rico, Ponce, PR 00731 (NS)
Vasquez, Pablo, Turabo University College, Turabo, PR 00625 (SS)
Vasquez-Geffroy, Margaret, New Mexico Highlands University, Las Vegas, NM 87701 (SS)
Vazquez-Ruiz, Francisco, University of Puerto Rico, Rio Piedras, PR 00931 (SS)

Villella, John, InterAmerican University of Puerto Rico, San German, PR 00753 (NS)
Von Blum, Ruth, National Science Foundation, Washington, DC 20550
Walker, John H., Florida Memorial College, Miami, FL 33054 (SS)
Wallace, Chuck, National Science Foundation, Washington, DC 20550
Wallace, David, Morristown College, Morristown, TN 37814 (SS)
Walther, Robert, Compton Community College, Compton, CA 90221 (NS)
Walton, Norman, Alabama State University, Montgomery, AL 36101 (SS)
Walton, Weldon, Paul Quinn College, Waco, TX 76704 (NS)
Ward, Donald W., Durham College, Durham, NC 27707 (SS)
Washington, Elmer, Chicago State University, Chicago, IL 60628 (NS)
Washington, Esther S., Howard University, Washington, DC 20029
Watkins, Nellouise D., Bennett College, Greensboro, NC 27420 (NS)
Watson, Odest, Bethune-Cookman College, Daytona Beach, FL 32015 (SS)
Watts, Marva, Malcolm X College, Chicago, IL 60612 (NS)
Webber, Clemmie, South Carolina State College, Orangeburg, SC 29117 (NS)
Weber-Levine, Margaret L., Morehouse College, Atlanta, GA 30314 (SS)
Welch, Evie, Edward Waters College, Jacksonville, FL 32209 (SS)
Weldon, Elbert, Altanta Junior College, Atlanta, GA 30310
Werner, Terry, Harris Stowe College, St. Louis, MO 63103 (NS)
White, Curtis, Harris Stowe College, St. Louis, MO 63103 (SS)
Wilkie, Elma, Turtle Mountain Community College, Belcourt, ND 58316 (SS)
Williams, John, Prairie View A & M University, Prairie View, TX 77445 (NS)
Williams, McKinley, Merritt College, Oakland, CA 94619 (SS)
Williams, Roger C., Morgan State University, Baltimore, MD 21239
Williams, Talmage, Control Data Corporation, Rockville, MD 20852
Wilson, Earl, Texas College, Tyler, TX 75702 (NS)
Wilson, Henry A., Barber-Scotia College, Concord, NC 28025
Wilson, Marion L., National Institutes of Health, Chicago State University, Chicago, IL 60628
Winborn, Martha, El Centro College, Dallas, TX 75202 (NS)
Woods, William, Philander Smith College, Little Rock, AR 72203 (NS)
Woodworth, Phyllis, East Los Angeles College, Monterey Park, CA 91754 (SS)
Yarbrough, Gilbert, Southwestern Christian College, Terrell, TX 75160 (NS)
Ybanez, John, Bee County College, Beeville, TX 78102 (SS)
Yong, Fook-Choy, University of New Mexico, Gallup, NM 87301 (NS)
Young, Gladys, Shorter College, North Little Rock, AR 72114 (SS)
Young, Phillip, Grambling State University, Grambling, LA 71245 (NS)
Zelman, Richard, Wayne County Community College, Detroit, MI 48201 (SS)
Zunes, John, Durham Technical Institute, Durham, NC 27703 (NS)

NS=Natural Science; SS=Social Science